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ABSTRACT

This hearing is the second in a series of hearings to be held by this subcommittee on the subject of "Women in Science and in Technology." The focus is on the issues of gender bias in precollege science and mathematics education. The first panel of witnesses will present the most recent data on the achievement, participation, and treatment of girls in math and science classes at the elementary and secondary school levels, and then use this data as a basis to suggest ways to improve our educational system. Witnesses include: Susan McGee Bailey, Center for Research on Women at Wellesley College, Wellesley, Massachusetts; Jane Butler Kahle, Miami University, Oxford, Ohio. The second panel of witnesses will focus on strategies and programs to increase gender equity, including both programs to provide increased math and science exposure directly to female students and strategies to provide training to teachers, parents, and guidance counselors. Witnesses on this panel include: Shirley Malcom, American Association for the Advancement of Science, Washington, D.C.; Richard E. Stephens, Office of University and Science Education Program, U.S. Department of Energy, Washington, D.C.; Jane Stutsman, Directorate of Education and Human Resources, National Science Foundation, Washington, D.C.; Stacy Kass, Careers and Life Planning, Girls, Inc., New York, New York; and Rebecca Failor, Math/Science Network, Oakland, California. An appendix contains a U.S. Department of Energy education programs catalog, 1994. Brief descriptions of each facility, its programs, and contact information are included. (MKR)

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# WOMEN AND K-12 SCIENCE AND MATHEMATICS EDUCATION

ED 382 463

## HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY

OF THE

COMMITTEE ON

SCIENCE, SPACE, AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

SECOND SESSION

JUNE 20, 1994

[No. 160]

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# WOMEN AND K-12 SCIENCE AND MATHEMATICS EDUCATION

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TUESDAY, JUNE 28, 1994

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Energy,
*Washington, D.C.*

The subcommittee met, pursuant to call, at 1:30 p.m. in Room 2325, Rayburn House Office Building, Hon. Marilyn Lloyd [chairman of the subcommittee] presiding.

Mrs. **Lloyd**. Good afternoon, ladies and gentlemen. The subcommittee will come to order.

Without objection, and I don't think there is anyone here to object, I would ask unanimous consent that today's proceedings be covered by the media.

As most of you know, this hearing is the second in a series of hearings to be held by this subcommittee on the subject of "Women in Science and in Technology."

The focus of today's hearing is on the issues of gender bias in precollege science and mathematics education.

Our first hearing was on May 12th and it focused on career options for women in science and engineering. It was based on the data that although women comprise 45 percent of the U.S. workforce they account for only 16 percent of employed scientists and about 18 percent of the employed engineers.

But today's hearings get back to the roots of the problem, to the reason why there are so few women in our technical workforce. The root of the problem can be traced all the way back to kindergarten and through the precollege education process, and that is why we are here today to focus on this issue.

We do have reasons that we are certainly going to consider today, research findings, and I do ask unanimous consent that my statement, my complete statement be made a part of the record.

[The prepared statements of Mrs. Lloyd and Ms. Eshoo follow:]

# THE HONORABLE MARILYN LLOYD
## OPENING STATEMENT
## "WOMEN AND K-12 SCIENCE AND MATHEMATICS EDUCATION"
## JUNE 28, 1994

Good afternoon. The Subcommittee will come to order. I would like to ask unanimous consent that today's proceedings be covered by the media. Without objection, so ordered.

This hearing is the second in a series of hearings to be held by the Subcommittee on the subject of Women in Science and Technology. The focus of today's hearing is on issues of gender bias in pre-college science and mathematics education.

Our first hearing, on May 12th, focused on Career Options for Women in Science and Engineering, and was based on the data that, although women comprise 45% of the U.S. workforce, they account for only 16% of employed scientists and engineers.

Today's hearing gets back to the roots of the problem -- to the reasons why there are so few women in our technical workforce. The root of this problem can be traced all the way back to kindergarten and throughout the pre-college education process, and that is why we are here today -- to focus on this issue.

Here are some of the research findings that will be discussed by our witnesses today:

- Teachers call on boys twice as often as they call on girls in math and science classes.
- When teachers call on boys, they tend to ask them how they got an answer or challenge them to find the correct answer. Girls tend to simply be praised if they get the right answer or corrected if they have the wrong answer.
- In coeducational group activities, boys tend to be the ones to run the equipment, leaving girls to record data or write up the results. One study found that by third grade, 51% of boys and 37% of girls had used microscopes.
- Seventh grade boys and girls performed equally well in math and science classes, but girls consistently underestimated their abilities. Girls tend to lose confidence in their abilities before any differences are measured in terms of achievement.
- In elementary school, 31% of girls believe that they are good at math; by middle school that number drops to 18%.

- The same percentage of girls and boys can be found in math classes up to the level of calculus; calculus is taken by 7.6% of boys and 4.7% of girls.

- Of those students who have taken both physics and calculus in high school, 64% of the boys and only 19% of the girls plan to major in science or engineering in college.

These gender issues in our elementary and middle schools stand at the entrance to a school-workforce pipeline that is losing women at every step along the way. Given these research findings, it should come as no surprise that women receive only 30% of bachelor's degrees in science and engineering fields, account for only 16% of employed scientists and engineers, and make up only 7% of tenured faculty in scientific fields. We are losing girls at every step along the way, and we can't allow this to continue.

When we shortchange our girls, we are compromising one-half of the human potential of our nation. The United States needs a technically literate, well-educated work force to ensure our economic development. The job market has fewer and fewer decently paid openings for the unskilled. Job seekers need skills in science, mathematics, and technology -- subjects girls are still being told are not suitable for them.

The first panel of witnesses at today's hearing will present the most recent data on the achievement, participation, and treatment of girls in math and science classes at the elementary and secondary school levels, and then use this data as a basis to suggest ways to improve our educational system. The witnesses will be Susan McGee Bailey, Ph.D., Executive Director of the Center for Research on Women at Wellesley College in Massachusetts, and Jane Butler Kahle, Ph.D., Condit Professor of Science Education at Miami University, and Chair of the Congressionally mandated National Science Foundation (NSF) Committee on Equal Opportunities in Science and Engineering. Dr. Bailey served as the project director and principal author of the 1992 report, "How Schools Shortchange Girls -- A Study of Major Finding on Girls and Education", a report prepared under contract from the American Association of University Women Educational Foundation to review all the available research on the subject of girls in school. Dr. Kahle has edited two books on the subject of women in science and technology: Double Dilemma: Minorities and Women in Science Education and Women in Science: A View from the Field.

The second panel of witnesses will focus on strategies and programs to increase gender equity, including both programs to provide increased math and science exposure directly to female students and strategies to provide training to teachers, parents, and guidance counselors. Witnesses on this panel will include Shirley Malcom, Ph.D., Head of the Directorate for

Education and Human Resources Program at the American Association for the Advancement of Science (AAAS), who will speak about the program "Girls and Science: Linkages for the Future," run by AAAS in cooperation with the Girl Scouts; Richard E. Stephens, Director of the Office of University and Science Education Program at the U.S. Department of Energy (DOE), who will discuss precollege science education programs funded by DOE; Jane Stutsman, Ph.D., Deputy Assistant Director of the Directorate of Education and Human Resources at NSF, who will discuss precollege science programs funded by NSF; Stacy Kass, the Director of Careers and Life Planning at Girls, Incorporated, who will testify about that group's program, "Operation SMART;" and Dr. Rebecca Failor, Past President of the Math/Science Network, who will discuss the "Expanding Your Horizons" Program, a program to encourage the participation of young women in mathematics and science.

## Testimony of Anna G. Eshoo

## before the House Energy Subcommittee

June 28, 1994

•Thank you, Chairwoman Lloyd. I am pleased to be part of today's subcommittee hearing on the status of science and math education for young women.

•This is the second in a two-part hearing on the role of women in science. Although not a member of the Energy Subcommittee, I have a special interest in this issue and thank Chairwoman Lloyd for her invitation to join these proceedings.

•I also want to welcome the distinguished members of the panels appearing before us today. It is rare to have six women testifying together before a Congressional committee. It is rarer still to have them testify on science and technology issues. I appreciate all of you appearing today and look forward to hearing your comments. You are all pioneers and you should be acknowledged as such.

•Gender equity is a problem plaguing America's science and mathematic infrastructure. Although making up 50% of the workforce, women constitute only 16% of employed scientists and 8% of employed engineers in the U.S.

•The bias against women in science begins early. Studies show that math and science teachers offer more attention to young men than young women. Young girls are not encouraged and not provided with adequate assistance. Studies show that as a result, many young women fall behind in their homework and achieve lower grades. As confirmed by recent reports, a lack of preparation and proficiency in mathematics is the single most important barrier keeping women from careers in engineering.

•The results of this system are predictable. Female students who receive less encouragement and less experience exert lower academic self-esteem and are less likely to pursue careers in math and science.

•This system must change. Our young women need a new formula for success, not an old formula for failure. They need to hear again and again that they can and should aspire to careers in science, and we in the Congress must help make their dreams come true.

•If, as a nation, we choose to pass over reforms which could provide young women opportunities in science and mathematics, we run the risk of losing one-half of our human potential and jeopardize the future competitiveness of our nation.

•I look forward to the testimony of the panelists today. And again, I thank you all for your important work. You are all profiles of tremendous success and you are our trail-blazers in your critical professions.

Mrs. LLOYD. But I am excited about our witnesses today because they will present the most recent data on the achievement, participation and treatment of girls in math and science classes at the elementary and secondary school levels.

Our first panel includes Dr. Susan McGee Bailey, Executive Director of the Center for Research on Women at Wellesley College in Massachusetts; Dr. Jane Butler Kahle, Professor of Science Education at Miami University, and she is chair of the congressionally mandated NSF Committee on Equal Opportunities in Science and Engineering.

We will welcome our second panel after we hear from these distinguished ladies. Ladies, you may summarize as you wish and your entire statement will be made a part of the record. Thank you so much for being here.

Dr. Bailey, will you be our lead witness?

## STATEMENTS OF SUSAN McGEE BAILEY, Ph.D., EXECUTIVE DIRECTOR, CENTER FOR RESEARCH ON WOMEN, WELLESLEY COLLEGE, WELLESLEY, MASSACHUSETTS; AND JANE BUTLER KAHLE, Ph.D., CONDIT PROFESSOR OF SCIENCE EDUCATION, MIAMI UNIVERSITY, OXFORD, OHIO

Ms. BAILEY. Madam Chair, thank you for the invitation to speak before the subcommittee today. I believe we are probably all in total agreement that we need in this era of technological advances, environmental crises and economic uncertainties a sound and solid education in math and science for all our students.

There are particular problems for girls and women in the sciences, and it is those issues that I will talk about today.

When we were putting the finishing touches on the report "How Schools Shortchange Girls," two and a half years ago, I remember feeling a sense of deja vu because we were definitely able to note progress and positive gains in that report. And for that report we reviewed over 1300 research studies, journal articles and books on the participation, the achievement and the treatment of girls and boys in schools.

But we still found a persistent set of inequities and stubborn inequalities, and this was 20 years after the passage of Title IX of the Education Amendments of 1972. So we can take hope from the progress that has been made by women and men who have pushed so hard for changes, but we still have a long way to go.

And there are two points that I would like to make before I begin a specific discussion of math and science that I think set the context in terms of our elementary and secondary school system.

One of the things that we did was to review 35 of the major reports on education reform. We started with "A Nation at Risk" in 1983 and we finished with "An Unfinished Agenda: A New Vision for Child Development and Education," which was published in 1991.

We were looking for recommendations, data, and discussion of girls in education reform. We found almost nothing. Only one report made a specific mention of Title IX and that notable lack of attention to full and genuine equality for girls and women in the remaining 34 reports wasn't a very auspicious beginning for our work.

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We also looked at data on the representation of women in positions of educational leadership, and in chart 1, that we will put up here on the overhead, we can see that women are far from equally represented among school principals and superintendents, even though elementary and secondary education is widely considered a woman's profession.

In 1992, women held 85 percent of all elementary school teaching positions and 55 percent of all high school faculty positions. I don't believe that men are any less interested in the education of girls than women are in the education of boys. People who enter teaching enter because they care about children. But I believe that we have to consider the subtle messages that such a sex division in leadership in education sends to students.

With this context in mind, I will talk briefly about math and science. I believe that nowhere, with the possible exception of sports, are the gains girls and women have made as clear as in the area of elementary and secondary school mathematics. That is the good news.

The problems remain but there is real progress. But we still have these frustrating and persistent barriers in careers in the physical sciences and engineering for women. If we look at the data in terms of where women are and where girls are in math and science at the elementary school it is important to note at the beginning that there is very little information that allows us to look at racial, ethnic group, sex and socioeconomic status at the same time. So we can talk about and compare girls and boys in each of those groups, but we cannot compare across groups, and we need more data.

So, the data that I am talking about today is limited in the sense that it doesn't allow a full comparison. There are still wide gaps in math and science achievement between white students and students of color, between lower socioeconomic students and higher socioeconomic students.

But the good news, the gender gap in math has definitely decreased. But, and there is always a "but," there are still gaps and they have to do with the more academically select and higher cognitive levels. That when you move to that level you find that there is a widening gap between girls and boys.

Sex differences in tests of spatial skills are also declining, and one large study found that girls and boys gained equally from instruction in spatial visualization skills despite initial differences favoring boys. I think it is very important to note this progress because I think it puts to rest what I think was a journalistic invention that there was some sort of math gene.

Genes don't change that fast. If we can make this much progress in 10 or 20 years, we can clearly see that the effort that we put into this matters, that it does make a difference, that obviously the majority of girls are as capable as the majority of boys. What they need and deserve is encouragement and opportunity.

I think most of the improvement in math is due to math course-taking patterns. Girls and boys are taking roughly equal numbers of math courses. But, and the same old "but" again, it is up to calculus. When you look at calculus, more boys are taking calculus than are girls.

When you look at science course-taking patterns, you also see that girls simply are not enrolled in physics, so that what is happening is that girls are leaving high school less well prepared for careers in the physical sciences and engineering than are boys. They haven't taken the courses.

Even when they have taken courses—and I am going to skip here and not use my second chart because I know our time is short. I am going to talk about the fact that even when students have taken courses in math, in science, in physics, in calculus, and you ask them about their career plans—and this would be the fourth chart—you see that less than 20 percent of the girls are seriously considering a career in science and engineering, but over two-thirds of the boys are.

Why these differences? Why are girls not taking the courses? Why are they not thinking about these things?

I think that one of the things that it is important to remember is that as girls and boys grow they have different experiences in science. We reported on how girls—how schools shortchanged girls. That girls are more apt to be exposed to biology-related activities and less apt to engage in mechanical and electrical activities, mirroring a course-taking pattern in the sciences that finds girls taking more biology courses but less of the advanced chemistry and not very much of the physics.

Furthermore, there are research studies that reveal a tendency, beginning at the preschool level, for schools to choose classroom activities that will appeal to boys' interests and to select presentation formats in which boys excel or are encouraged more than are girls.

For example, when researchers looked at lecture versus laboratory classes they found that in lecture classes teachers asked males academically related questions about 80 percent more often than they questioned females. The patterns were more mixed in laboratory classes, but in most of our science courses today in high school we find that lectures are the more common form of instruction.

Another study of science classes found that when teachers needed assistance in carrying out a demonstration 79 percent of the demonstrations were carried out by boys. Science classrooms are often dominated—

Mrs. LLOYD. Did the girls keep the records?

Ms. BAILEY. The girls keep the records. Yes, I guess that would be the usual role.

I believe that science classrooms are dominated often by boys because they have more extensive out-of-school experience and familiarity with things. But I think we also have to look at the research that indicates that classrooms are more apt to be dominated by boys because boys often tend to dominate classrooms in general.

After the report came out, Garry Trudeau did a series of comic strips, and in one of them a mother is putting her daughter to bed and she asks her daughter, "How was school?" And she says, "Okay, except I never get to say anything."

The mother is very worried about this. She said, "What do you mean?" And she said, "Well, the teacher just calls on the boys."

So, the mother thinks about it and she says, "Well, I better go into school and have a little talk with her." And there is a slight pause and then a horrified look on the daughter's face, and she says, "Oh, mom, she will never call on you. Send daddy."

And I believe that the evidence is quite clear. Research studies done in a variety of settings by different research teams over the last 20 years all indicate that on average and in most classrooms boys get more of a teacher's time and attention than girls do.

Now, most teachers, and as a former teacher I fall into this group, will tell you that that is because boys demand more attention. But it is more than that.

Part of the problem is traditional assumptions that we all hold about sex roles and appropriate roles for girls and boys. We all know girls are listening. We all know they are taking the notes. We all know that they will do a good job at the end of the year and get a good grade, so there is nothing to worry about.

But, if we expect girls to be active participants in the sciences, in business and in politics, we have to encourage and expect them to do more than be good listeners. And furthermore, I think that if we value listening skills, and I think we do, then it is definitely unfair not to provide more opportunities for boys to listen. And I think that is something that we need to worry about in our classrooms.

I think another issue is that we need to think about the ways boys treat girls in schools. I don't think that is a factor that can any longer be overlooked or joked away when we look at factors affecting girls' participation and achievement in school.

Sexual harassment is, unfortunately, all too alive and well in our Nation's schools and it is preventing girls from full participation in educational programs. I believe that when we ignore sexist behavior in our schools we prepare students for it in the workplace.

We send a terrible message to both girls and boys. The message to girls, You need to get used to this. The message to boys, This is how real men behave. And they are messages that are demeaning and insulting to women and to men, and they feed exaggerated sex role stereotypes.

And to get to the bottom of the issue of why we don't have more women in the physical sciences and engineering, I think that sex role stereotypes and expectations that go along with that play a very significant role.

One of the things that I think we need to do to address the problem is to find ways to break some of the sex role stereotypes and expectations to bring people into the classroom to show both girls and boys that women as well as men can be scientists. That people of different racial and ethnic groups as well as just white men can be scientists.

I think we need to look at our textbooks. We have made a lot of progress in textbooks, but textbooks still send a message that this is what we consider the appropriate role and the appropriate job and the appropriate career for girls and boys. Even the newest textbooks aren't terrific, and not all schools can buy the newest textbooks. And some of these same stereotypes are also being played out in the software and the computer games that kids are playing today. They all play into this same gender stereotyping and sex role stereotyping.

We looked before at the positions of leadership in education, principals and superintendents. But I think it is interesting to look at the number of teachers and the sex of the teachers who are teaching math. That is the last overhead that I have.

And here again it plays out. We find more men, even though, as you remember, I stated that men were in the minority in terms of teaching positions in elementary and secondary education, in general they are in the majority of those who are teaching in our science and mathematics classrooms. And, of course, it is a vicious cycle, and we have to intervene at some point. But that again feeds into the stereotype of what girls should study and do, what boys should study and do.

And I think that I should end at this point. As you know from my testimony, written testimony, I have several other charts and lots more statistics. But everyone can read that or we can talk about it later.

[The prepared statement of Ms. Bailey follows:]

## Women and K-12 Science and Mathematics Education

Testimony before the Subcommittee on Energy
U.S. House of Representatives
June 28, 1994

Susan McGee Bailey, Ph.D.
Executive Director
Center for Research on Women
Wellesley College

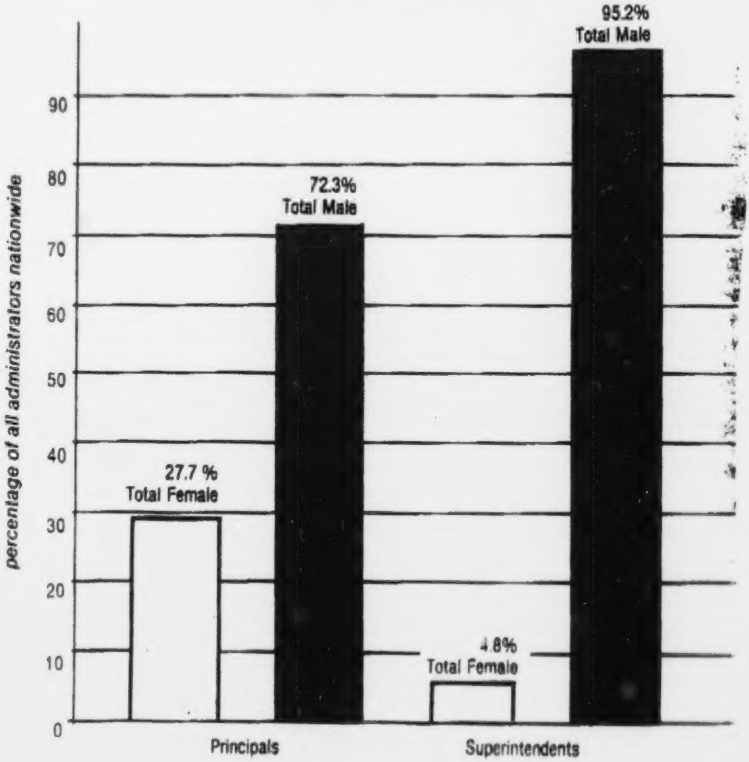
Madam Chair, thank you for your invitation to speak before the Subcommittee today on a topic I believe is crucial to our national future. In an era of rapid technological advances, environmental crises and economic uncertainties, an excellent education, including education in the sciences and mathematics, for *all* our students, boys *and* girls from every socio-economic level and all racial, ethnic and cultural backgrounds is critical. We have a long way to go to achieve this goal and the particular educational problems confronting girls and women in the sciences are one of the barriers to progress. It is these issues I will address today.

When we were putting the finishing touches on the report How Schools Shortchange Girls two and a half years ago I remember feeling a sense of deja vu. While we definitely were able to note progress and positive gains in that report which reviewed over 1300 research reports, journal articles and books on the participation, achievement and treatment of girls and boys in schools, the overall picture was one of persistent inequities and stubborn inequalities for girls and boys in our nation's elementary and secondary schools. This was almost 20 years after the passage of Title IX of the Education Amendments of 1972 which forbids discrimination on the basis of sex in educational programs receiving federal funds. One minute I took hope from the clear difference made by women and men who pushed hard for changes and the next I was discouraged by the long way we still have to go.

Before turning specifically to the data on mathematics and science, there are two pieces of more general information that may help to set the context for our discussion. As we began work for the AAUW Educational Foundation on the status of girls in U.S. public elementary and secondary schools we reviewed 35 of the major national reports on education reform starting with A Nation at Risk in 1983 and concluding with Unfinished Agenda: A New Vision for Child Development and Education published in 1991. We were looking for recommendations, data and discussion of girls in schools. We found almost nothing. Only *one* of the 35 reports we reviewed made a specific mention of Title IX. Barriers to Excellence: Our Children at Risk (1985) called for greater attention to equal educational opportunities for girls and young women as part of the reform and restructuring of America's schools. The notable lack of attention to full and genuine educational equity for girls and women in the remaining 34 reports was not an auspicious beginning for our work.

Chart 1

## School Superintendents and Principals (1990)



Graph excludes states that do not report data by sex and race.
Source: *Women and Minorities in School Administration: Facts and Figures 1989-90.* American Association of School Administrators.

I do not believe that men are any less interested in the education of girls than women are in the education of boys. Most people who enter teaching do so because they care about children. But I do believe that we must consider the subtle messages such a marked sex division in leadership sends to students. The absence of sex and gender equity considerations as we think about the restructuring of education cannot continue.[1] Gender equity must be a basic ingredient in every phase of our education reform efforts. So far this has not been the case.

With this context in mind, I will move now to a more specific focus on mathematics and science.

No where, with the possible exception of sports, are the gains girls and women have made as clear as in the area of elementary and secondary school mathematics. Problems of course remain, but there *is* real progress. And no where do the barriers appear to be so frustratingly persistent as in careers in the physical sciences and engineering for women. For decades we have discussed the necessity, both in terms of strategic national economic and security needs as well as on the basis of equity and fairness, to open up career opportunities for women in science and engineering. Today

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[1] The terms *sex* and *gender* are often used interchangeably. In this paper *sex* is used when referring to individuals as biologically female or male, and *gender* when also referring to differing sets of expectations and limitations imposed on people simply because they are female or male.

45% of our national labor force is female but still only 16% of the scientists and 8% of the engineers are female.

What I would like to do this afternoon is review some of the research on the achievement, participation and treatment of girls at the elementary and secondary level in science and math, talk briefly about data that indicates how young girls view science and then focus on some steps we can take to address the problems at an early stage. Work at the university level to retain women in science courses and engineering programs is critically important but it is not sufficient.

As I discuss this data you will note the lack of information on various groups of girls. One of the most difficult problems we ran into as we worked on How Schools Shortchange Girls was the absence of data that looked at sex, race/ethnicity *and* socio-economic (SES) class simultaneously. One can compare students on these individual variables but very few studies allow three-way or even two-way comparisons. Assuming all *girls* are the same is no better than assuming all *students* are the same; we need much more attention to sex *and* race/ethnicity *and* class in our educational research and reporting efforts. Obviously *all* are factors affecting participation in the sciences.

The overall gap in science and math achievement between white students and students of color remains very large. African American and hispanic students are almost twice as likely to be in remedial math classes as are white students, and low SES students are more than twice as likely as high SES students to be in remedial math. Furthermore, the National Center for Education Statistics reports that 50% of high income students take algebra and advanced mathematics classes, but that only 28% of middle income students and 15% of low income students are in these classes. What we need to look at with particular care is how girls are fairing compared to boys in these groups but the data are extremely sparse.

Let's look first at the good news. Sex differences in mathematics achievement are small and declining. Recent meta-analyses have found only small differences in female and male performance in mathematics. Furthermore, meta-analyses comparing recent research with studies done in the 1970's indicate a significant decline in sex differences (Friedman, 1989; Hyde, Fennema & Lamon, 1990).

But, and unfortunately there is always a but...sex differences in mathematics *do* exist. They are related to the age of the sample, how academically selective it is, and which cognitive level the test is tapping. For example, no sex differences were found in the problem-solving ability of elementary-and middle-school girls and boys, but moderate to small differences favoring males emerged in high school (Mullis, 1991).

Larger differences are found at the higher academic and cognitive levels. One study revealed that nearly all differences in math performance between girls and boys at ages eleven and fifteen could be accounted for by differences among those scoring in the top 10-20 percent, with boys more often in the top-scoring groups (Stockard & Wood, 1984). Here the most recent news is very unsettling for the only place where the math "gender gap" is *widening* is among top scoring students in 8th grade. Furthermore, while sex differences on the SAT-Math have decreased, they are still large.

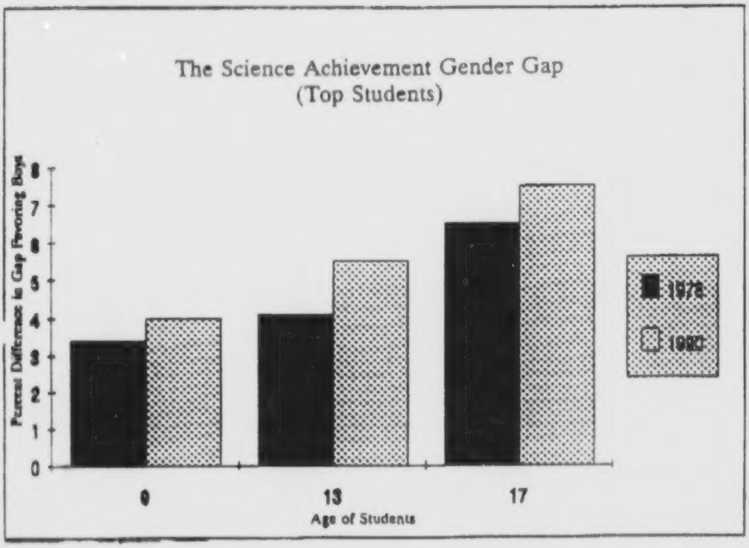
Sex differences in tests of spatial skills are also declining. One large study found that girls and boys gained *equally* from instruction in spatial-visualization skills, despite initial differences favoring boys (Linn & Hyde, 1989). These dramatic improvements over time are strong evidence that the so called "math gene" is a figment of a journalist's imagination. Gene's don't change in a decade or two but education and societal expectations can and do. The majority of girls are obviously as capable as the majority of boys in these areas. They need, and deserve, encouragement and opportunity.

Much of the improvement that has been made may well be due to course taking patterns in mathematics. Sex differences in math-course participation are small, occur only in higher-level courses, and appear to be stable. The National Science Board found that approximately the same percentages of females and males took the same math courses -- *up to calculus*, which was taken by 7.6 percent of the boys but only 4.7 percent of the girls.

The news in science is not as encouraging. Sex differences in science achievement are not decreasing and may be increasing. The National Assessment of Educational Progress (NAEP) tracks science performance. Its results indicate that for nine- and thirteen-year-olds, sex differences in achievement increased between 1978 and 1986, due to the combination of a lag in performance for females and significant increases in the performance of males. According to the NAEP, sex differences in science achievement are larger for seventeen-year-olds, and these differences have not changed since 1978. The areas of largest male advantage are physics, chemistry, earth science, and space sciences.

In addition, sex differences exist at various levels of achievement. In fact, gender differences favoring boys are *increasing* in science achievement at 4th, 8th and 12th grade for top students. There appears to be a particular problem nationally at the eighth grade level where, as I mentioned a moment ago, the differences among top students are increasing in math as well as in science (see Chart 2).

Chart 2



Data from the National Assessment of Educational Progress.
Chart developed by Patricia Campbell

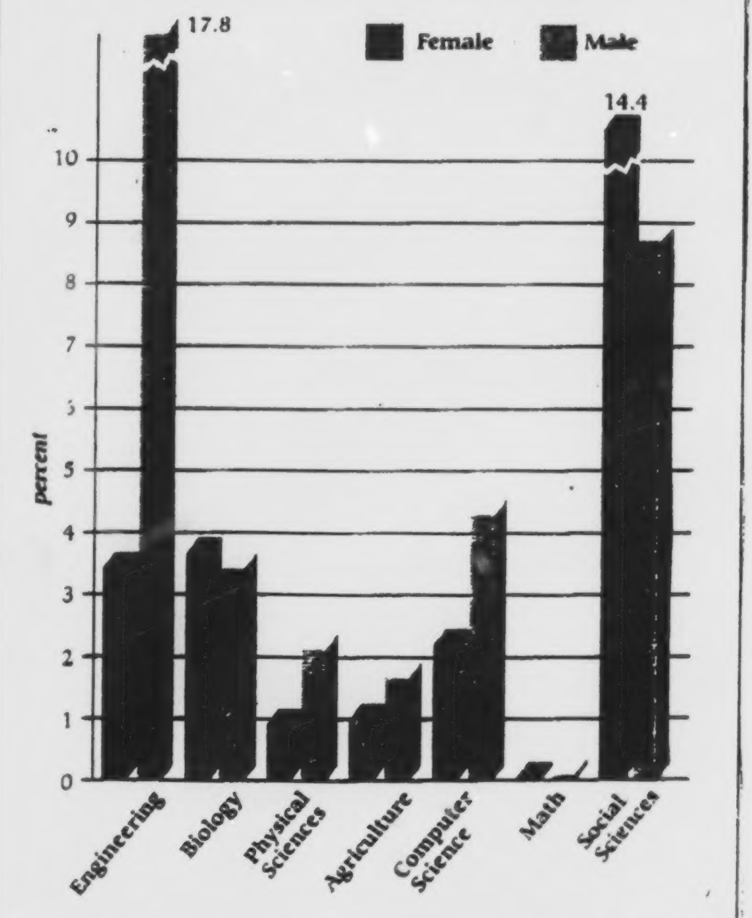
What about course taking in science? Sex differences in the number of science courses students take are small. However, the *pattern* of course-taking differs, with girls being more apt to take advanced biology and boys being more apt to take physics and advanced chemistry.

Approximately the same numbers of females and males take Biology I and Chemistry I but more males take physics. The Council of Chief State School Officers' survey reports that 60 percent of the students enrolled in first-year high school physics are male and that 70 percent of second-year physics students are male. The evidence is clear: girls are leaving high school less well prepared for careers in the hard sciences and engineering. They simply are not taking calculus and physics courses to the same extent as are their male classmates.

How are these achievement and participation patterns reflected in career plans? Sex differences show up in career plans as well. High school girls, even those with exceptional academic preparation in math and science, are choosing math/science careers in disproportionately low numbers (see Charts 3 and 4).

Chart 3

Career Plans of Students Taking the SAT



*Women and Minorities in Science and Engineering* (Washington, DC: National Science Foundation [1990], p. 14).

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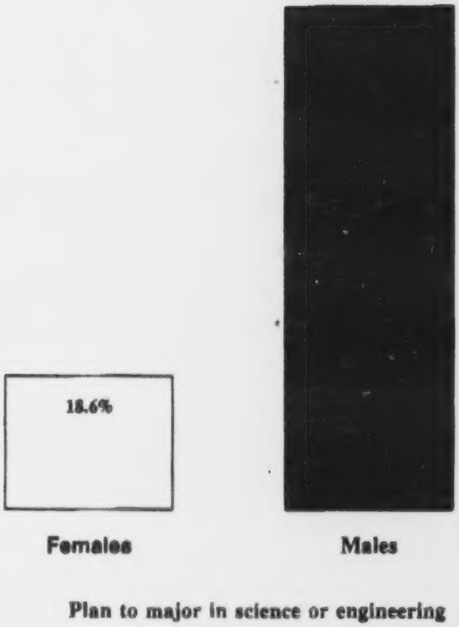
Chart 4

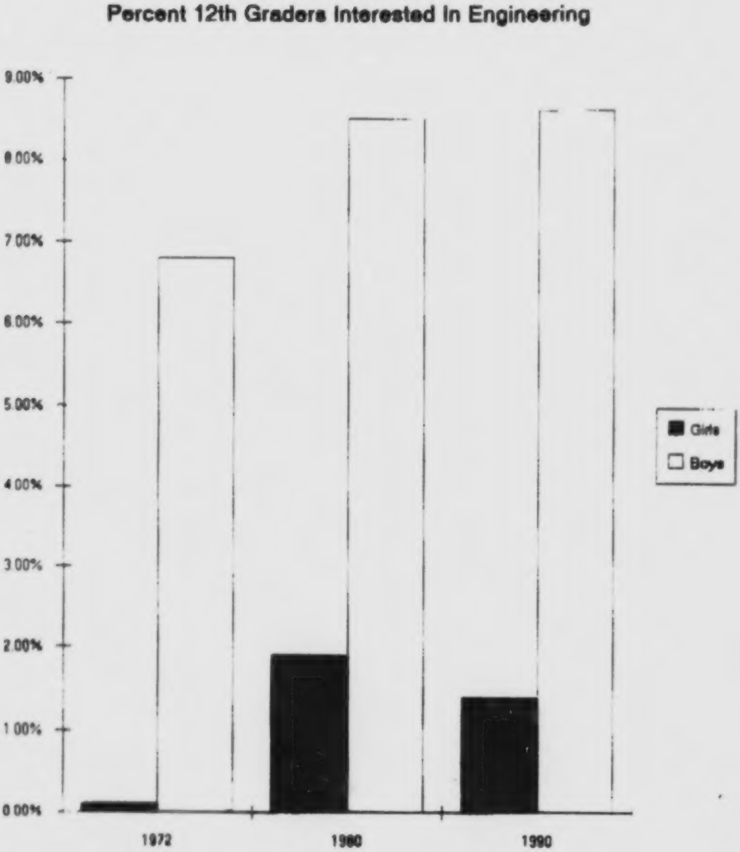
## College Plans of High School Seniors Taking Physics and Calculus



T. Dick and S. Rallis, "Factors and Influences on High School Students' Career Choices," *Journal of Research in Mathematics Education* (1991)

Between the 1970's and 1980's there were important increases in the numbers of girls and women interested in math related careers. In 1972 boys were 68 times more apt to be interested in engineering, (.1% of the girls and 6.8% of the boys). By 1980 this had been reduced to boys being 4.5 times more likely than girls to be interested in engineering (1.9% of girls to 8.5% of boys). However, between 1980 and 1990 the percent of high school senior girls interested in engineering decreased from 1.9% to 1.4% while the percent of high school senior boys interested in engineering stayed about the same (8.5% to 8.6%; see Chart 5).

Chart 5



Data from the National Science Foundation.
Chart developed by Patricia Campbell

The Pathways for Women in Science Project sponsored by the Sloan Foundation at the Center for Research on Women is following young women as they enter Wellesley College to better understand their decisions to pursue, or not to pursue, science. Results from the first year indicate that very few students declared a science major if they had not already developed an interest in high school. Furthermore, support for pursuing science from multiple sources is very important for young women.

Other research indicates girls who do go on into scientific fields after high school report that the encouragement provided by their teachers is important. One study reported that girls who went on to study engineering felt that teachers encouraged them; unfortunately they also felt that their guidance counselors discouraged them (Campbell & Metz, 1987).

What is going on that can help us account for these differences? As they grow, girls and boys have different science experiences. We reported in How Schools Shortchange Girls that girls are more apt to be exposed to biology-related activities and less apt to engage in mechanical and electrical activities. One study found that by third grade, 51 percent of boys and 37 percent of girls had used microscopes, while by eleventh grade 49 percent of males and 17 percent of females had used an electricity meter (Mullis & Jenkins, 1990). Another study reports eighth-grade boys have been found to use more science instruments in class, particularly physical-science tools, such as power supplies (Zimmer & Bennett, 1987).

Although nine-year old girls express interest in many science activities, they do not *do* as many as boys. This sex difference continues through ages thirteen and seventeen and is paralleled by an increasingly negative view of science, science classes, and science careers on the part of girls (Zimmer & Bennett, 1987). Girls simply do not see science as something girls do.

Research studies reveal a tendency beginning at the preschool level for schools to choose classroom activities that will appeal to boys' interests and to select presentation formats in which boys excel or are encouraged more than are girls. For example, when researchers looked at lecture versus laboratory classes, they found that in lecture classes teachers asked males academically related questions about 80 percent more often than they questioned females; the patterns were mixed in laboratory classes (Baker, 1986). However, in science courses, lecture classes remain more common than laboratory classes.

Furthermore, a study of science classes found that when teachers needed assistance in carrying out a demonstration 79 percent of the demonstrations were carried out by boys (Tobin & Garnett, 1987). Science classrooms are often dominated by boys in part because boys have more extensive out of school familiarity and experience with the subject matter. They are also more apt to be dominated by boys because boys are often more apt to dominate in classrooms regardless of the subject matter!

After the report on girls in schools was released, Garry Trudeau did a series of comic strips. My favorite is one in which a mother is putting her daughter to bed and asks her how school is going. The daughter replies that it's OK but she never gets to say anything. Her mother is shocked, "What do you mean?" she asks. "Well, the teacher just calls on the boys," her daughter replies. The mother thinks for a moment and then says, "Well, maybe I should go in to school and talk with the teacher about this." Her daughter responds, "Oh, Mom, she'll never call on you, send Daddy!"

Research studies done in various settings by several different research teams over the past 20 years all indicate that, on average, in most classrooms, boys get more of teachers time and attention than do girls. Most teachers, and I am one of them, will tell you that this is usually because boys demand more attention, but boys' demands are not the only explanation. Our traditional assumptions about appropriate gender roles play a part as well. After all, we know the girls are listening and taking notes as girls are supposed to, they'll get a good grade, there's nothing to worry about. But if we expect girls to be active participants in the sciences, politics and business, they need to be expected and encouraged to do more than be good listeners. And if we value listening skills, as we do and should, then how unfair not to provide more opportunities for boys to practice listening!

The way boys treat girls in school is another factor that can no longer be overlooked or "joked-away" when considering factors affecting girls' participation and achievement in school. Sexual harassment is, unfortunately, alive and well in our nation's schools and it is preventing girls from full participation in educational programs. When we ignore sexist behavior in our schools we prepare students for it in the workplace. We send a terrible message to *both* girls and boys: girls, you need to get used to this; boys, this is how "real men" behave. These messages are demeaning to women and to men and they feed exaggerated gender role stereotypes.

Gender stereotyping influences whether girls persist in mathematics. Data from the National Assessment of Educational Progress indicate that girls who reject traditional gender roles have higher math achievement than girls who hold more stereotyped expectations. Moreover, girls in advanced math classes tend to be the girls who do not see math as a "male" subject (Armstrong, 1985). A longitudinal study that tested students at sixth, eighth, tenth, and twelfth grades found that for girls a view of math as "male" was negatively correlated with math achievement at each grade level (Tartre & Fennema, 1991).

Furthermore, females, more than males, seem to doubt their confidence in math. The Educational Testing Service reports that sex differences in perceptions of being good at math increase with age. Third-grade girls and boys think they are good in math in about the same percentages (64 percent versus 66 percent); by seventh grade, 57 percent of the girls agree, compared to 64 percent of the boys; by eleventh grade the gap widens to 48 percent of girls versus 60 percent of boys. In a classic study, researchers Elizabeth Fennema and Julia Sherman found a strong correlation between math achievement and confidence. Their research revealed a drop in both girls' math confidence and their achievement in the middle-school years. The drop in confidence *preceded* a decline in achievement.

Females and males abandon math and science for different reasons. Males who drop out of math and science tend to do so because of a lack of competence -- they cannot *do* the work; many females who drop out do so even though they *can* do the work -- they just don't *think* they can, they aren't sure enough (Leder, 1990, AAUW, 1990).

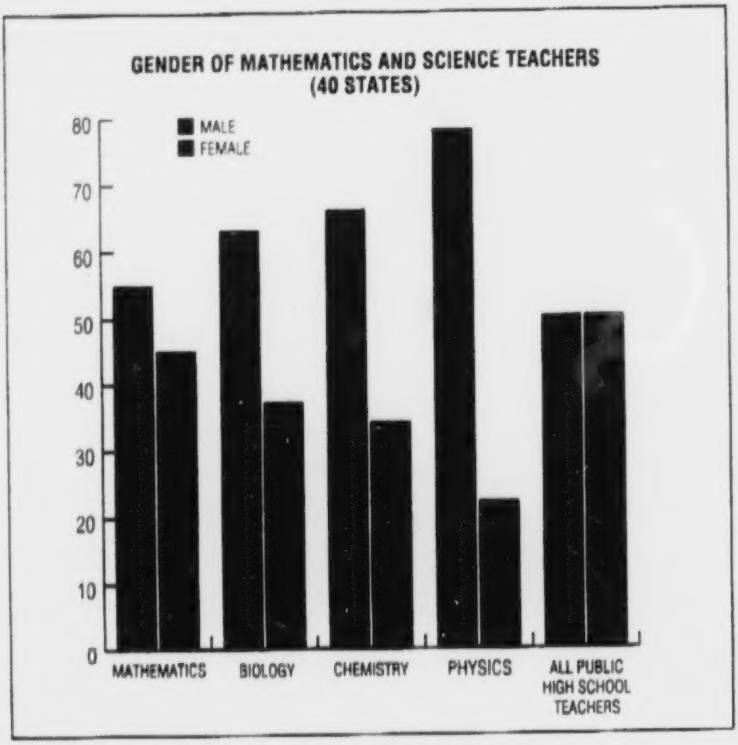
Concern about the difficulty or competitiveness of the field can also be an issue. Campbell and Metz (1987) found that the perceived competitiveness of engineering was seen by girls as a major barrier to women entering the field. This finding is supported by research that shows girls who see themselves as highly competitive are more interested in taking math and science courses than other girls. For boys, the degree of competitiveness is not related to interest in taking math and science (MacCorquodale, 1984).

**What can we do?**

Changing the public images of physics and chemistry to reflect the diversity of these fields and the way they tie in to our everyday lives can provide more girls with the "inside information" that daughters of scientists appear to get. (At the moment the best predictor of whether a girl will pursue science appears to be whether she has a parent who is a scientist!) Meeting, getting to know, and working with scientists also reduces the negative and intimidating stereotypes about the field. Providing students, especially girls, with more real-life experiences with science and scientists may make a big difference.

At this point it is interesting to look at the percentages of male and female teachers in U.S. public high schools. As Chart 6 indicates, public school teachers are roughly 50/50 male and female. The sexes are not equally represented in the teaching ranks in our science and mathematics classrooms, however. Men outnumber women by a significant margin. Once again, adult role models can send a subtle, if unintended, message.

Chart 6



*Source: State Departments of Education, Data on Public Schools, Fall 1989; N. Carolina, Fall 1988.*
*Council of Chief State School Officers, State Education Assessment Center, Washington, DC, 1993.*

**Source:** *State Indicators of Science and Mathematics Education.* (Washington, DC: Council of Chief State School Officers, 1993) p. 14.

There are a number of teaching strategies that can promote more gender-equitable learning environments. Research indicates that science teachers who were successful in encouraging girls, share several strategies. These included using more than one textbook, eliminating sexist language and showing fairness in their treatment and expectations of both girls and boys (Kahle, 1985).

Textbooks are a key element. They send powerful messages to students. They signal to students what is and is not appropriate for girls and boys, for members of various racial/ethnic and cultural groups. Progress has been made, but students of both sexes are still exposed to gender stereotyping in too many of the materials they study in school; the textbooks (not all schools buy the very newest), the videos, the computer software (Huff & Cooper, 1987).

There is evidence that if pupils begin working on an activity with little introduction from the teacher, everyone has access to the same experience. Discussion that follows after all students have completed an activity encourages more participation by girls. In an extensive multi-state study, researchers found that in geometry classes where the structure was changed so that students read the book and did problems *first* and *then* had classroom discussion of the topic, girls outperformed boys in two of five tests and scored equally in the other three. Girls in the experimental class reversed the general trend of boys' dominance on applications, coordinates and proof taking while they remained on par with boys on visualizations in three dimensions and transformations. In traditional classes where topics were introduced by lecture first and then students read the book and did the problems, small gender differences favoring boys remained (Flores, 1990).

Schools can learn much from out-of-school programs that encourage girls in math and science. Girls are not required to take special out-of-school programs. Designers of successful out-of-school math and science programs have learned how to get girls to attend and, more important, how to keep them interested so that they will keep on attending. We need to continue and expand programs like those developed by Girls, Incorporated and the Girl Scouts. These offer unique opportunities for girls to learn together to overcome stereotypes. What's more, such programs also act as laboratories for developing effective techniques to keep girls involved in math and science. We can't rely on these programs alone, however. Compared to the school system, they can reach only small numbers of girls for relatively short periods of time. Since all girls go to school and go for many years, we must focus most of our effort there, incorporating successful out-of-school techniques within our schools and classrooms.

Mrs. LLOYD. We are all taken by your testimony. I think we could sit here and listen to you all afternoon. But in fairness to our other witness, I will call on Dr. Kahle at this time.

Ms. KAHLE. Thank you, Madam Chairman and members of the subcommittee for this opportunity to testify.

A review of science and mathematics education for girls, particularly for girls of color, is severely restricted by the type and number of individual studies as well as by the nature of the analyses that are available in national data sets. Available data are seldom disaggregated by race, ethnicity and sex, or by socioeconomic level and sex.

In fact, if my testimony leads to only one outcome, many of my colleagues and I hope that it will be a congressional directive to the National Center for Educational Statistics to require that National Assessment of Educational Progress (NAEP) data be reported by sex within each racial/ethnic group.

Although I am acutely aware that different factors affect Appalachian girls in Tennessee, Chicano girls in Texas, Asian American girls in California, the data are not analyzed in ways that allow specific targeted studies that can lead to change.

During the seventies and mid-eighties Federally funded projects addressed the different interest in achievement levels in science and math for girls and boys. However, partly due to changes in funding priorities in the mid-1980s many of those programs as well as the gains made by girls and women have leveled or declined.

For example, between 1982 and 1986 the percentage of girls enrolled in high school precalculus and calculus declined from 45 percent to 39 percent. The number of college women electing computer science majors and engineering majors peaked in 1984 and has declined since then. Between 1970 and 1986 the gender gap between 13-year-old girls and boys—favoring boys—in NAEP, science proficiency scores doubled.

Girls and boys are treated differently in school. Differences in classroom interaction patterns in math and science are consistent: more frequent interactions with boys, fewer challenging questions to girls, fewer opportunities for girls to manipulate equipment, and many examples and exemplars related to masculine activity.

It has been estimated that on the whole teachers spend 44 percent of their time with girls and 56 percent of their time with boys resulting in 1800 hours, more hours of teacher instructional time over 12 years of schooling for boys, and the differences begin early.

Neither kindergarten boys nor girls can define science. But even without that knowledge Pat Campbell reports that more boys than girls reply they want to be scientists, that they are good in science and that they have done science. As early as fourth grade girls show a preference for biological topics while boys, many of whom have had, as Susan mentioned, these important out-of-school activities with mechanical and electrical equipment, choose topics in physical science.

When science curricula is based on either girls' expressed interest or in teacher interest they severely limit girls' educations in science, eventually resulting with 15 percent of girls enrolled in high school physics while 25 percent of our boys do physics.

As a group, teachers hold stronger sex role stereotypes and views about the appropriateness of specific science activities for girls and boys than students do. Most elementary teachers are women who have chosen elementary education in college partly to avoid rigorous science and mathematics courses.

A recent report of the National Research Council describes the woeful lack of adequate preparation in science, usually 6 to 9 undergraduate hours, and to a lesser extent in mathematics, for elementary teachers. Initiatives such as that of the Holmes Group consortium that require degrees in a discipline-based major for perspective teachers have acerbated the situation, for most choose majors—sociology, psychology, English literature—that have even fewer required courses in science and math than teaching majors do.

Interviews of parents—over 5,000 parents, actually—in Michigan revealed the effect of parental stereotypes on children's choice of math classes as well as on their opportunities for out-of-school science activities.

However, math is still considered a basic by both parents and teachers, and because of that boys and girls value mathematics and have positive attitudes about the study of math. According to NAEP surveys, there is little or no decline in girls' or boys' perception of the value of a career in math or the usefulness of math between the ages of 9 and 17, and Eccles' work at the University of Michigan shows a positive relationship between perceived value and usefulness of a subject and student enrollment and achievement in that subject.

In the last two decades the positive attitudes of girls about the value and usefulness of math have affected the course selections, eliminating sex differences in everything but precalculus and calculus. However, and this is the bad news, NAEP surveys of science have shown that girls' attitudes about and interest in science begin to decline about grade 7.

For example, two-thirds of fourth grade girls and boys reply that what they learn in science class is useful in everyday life. However, boys retain that positive attitude throughout high school, while girls' perceptions of the utility of science drop precipitously.

A longitudinal study of American youth explains why girls and boys choose not to study mathematics or science during their senior year—the key year—of high school, and the effects of both attitude differences as well as sex bias counseling are evident. Although the same two reasons "do not like" and "advise not to take" are the most commonly selected by boys and girls, 10 percent more girls than boys choose those reasons.

Although not disaggregated by sex, NAEP data on surveys of science since 1976 have found that minority children hold much more positive attitudes about science than white children do. Furthermore, the findings of several independent researchers suggest that coursework experiences have significant positive effects on the math and science performance of ethnic or racial minorities. However, in two decades we have not found a systematic way to relate positive attitudes to enrollment.

Sex based differences in attitudes and interest as well as in confidence and achievement levels in school math and science vary among several racial groups. For example, my work and that of James Campbell and Diane Pollard suggests that white females hold much more sex role stereotyped views about themselves and science than do either Asian or African American girls.

Early programs designed to intervene in a girl's choice not to study math and science were originally funded by the Women's Educational Equity Act for the U.S. Department of Education or by the Education, and now the Education and Human Resource, Directorate of the National Science Foundation.

But most projects addressed differences between boys and girls, and most were based on a deficit model. That is, changes were needed in girls' attitudes, interest and confidence to make them more like boys. Some of the most successful projects—Equals, Family Math, Family Science—were begun at the Lawrence Hall of Science but have since become national programs. Others have involved private groups such as the Girl Scouts and Girls, Incorporated. Although individual girls seem to derive immediate benefits from such programs, there have been few long-term studies of persistent gains.

We know what works for girls, and boys, who traditionally have not shown an interest in science and math. In 1985 I described strategies of high school biology teachers that increased the number of girls, including minority girls, who continue to study high school science and major in science in college. They included the increased use of laboratories and discussions, teacher involvement in education and career counseling, inquiry, creative, and basic skill activities, and field trips as well as other out-of-school activities.

Similar work has been done in mathematics. Eccles' work suggests that the increased use of cooperative, hands-on, practical problem-solving activities improves mathematics instruction for girls and minority students. A decade of studies reveal that teachers—in the case I am reporting on they were all male—who participate in equity education improved rural girls' attitudes about and motivation in science.

Small learning groups, often thought to be a panacea, are only effective with girls in science and math if teachers monitor those groups for cooperation. Content-based activities that develop spatial relationships eliminate the sex difference between girls and boys' scores in one semester.

Sex role stereotype behaviors, attitudes and expectations are changed by effective equity education in undergraduate teacher education programs. A prime example is at the University of Northern Colorado. Programs for practicing teachers that include both content and equity can change teacher expectations and behaviors as well as classroom instruction in science and math. Miami University and Cincinnati have a prime example there.

Furthermore, the proportion of girls who continue to study advanced mathematics and science is increased when teachers do specific compensatory activity. They have to make up the difference that the children bring to school.

Federal support of projects designed to increase the numbers of girls and women in science and mathematics or to analyze and alleviate differences between the sexes has been at best idiosyncratic.

Public interest and support varies in relation to supply and demand factors, including the availability of foreign male scientists. Program initiatives supported by Democratic administrations fall away under Republican ones and vice versa. Considering that girls and women are over 51 percent of our population, the only constant has been inadequate funding.

Although most Federal agencies do not have programs targeted for girls and women, the National Science Foundation does. Recently, it has revised and repackaged those programs to provide a more coordinated approach. Yet the dollars allocated for women's programs are still far fewer than those allotted to minority programs.

The NSF initiatives for under-represented minorities provide coherent long-term funding of multi-institutional and regional projects, while the programs for girls and women are limited in length, scope and budget.

We have moved beyond the deficit model to identify specific types of instruction and specific kinds of science and math classrooms that benefit girls and minority boys. This information needs to be compiled and widely disseminated to both prospective and practicing teachers.

Programs need to be monitored for persistent, not immediate gain. Critical entry points and transitions for girls need to be studied so that appropriate and effective counseling occurs. And school reform, especially in math and science must address transforming, not reproducing, the sex-role stereotypes that students and teachers bring to school.

Hungary led all other nations in the Second International Association for the Evaluation of Educational Achievement in Science—that is the IEA study—because its girls, unlike those of all other nations, scored as well as its boys. We cannot reach Goal Four unless the deficiencies in science and math education of girls are addressed and alleviated.

And I thank you very much for this opportunity to testify. I will be pleased to respond to your questions.

[The prepared statement of Ms. Kahle follows:]

Testimony of
Jane Butler Kahle
Condit Professor of Science Education
Miami University, Oxford, Ohio

Before the
Subcommittee on Energy
House Science, Space and Technology Committee
U.S. House of Representatives
June 28, 1994

Thank you Madam Chairman and members of the Subcommittee for providing the opportunity for me to testify concerning the entrance, retention, and success of girls and women in science, mathematics, and engineering. My remarks are based on the findings of large national databases, of individual research studies, and of two decades of my research group's work with students and teachers.

## Introduction

A review of science and mathematics education for girls, particularly girls of color, is severely restricted by the type and number of individual studies as well as by the nature of the analyses that are available on national data sets. Available data are seldom disaggregated by race/ethnicity and sex or by economic level and sex. In fact, if my testimony leads to only one outcome, many of my colleagues and I hope that it will be a Congressional directive to the National Center for Educational Statistics to require that National Assessment of Educational Progress (NAEP) data be reported by sex within each racial/ethnic group. Although I am acutely aware that different factors affect Appalachian girls in Tennessee, Chicano girls in Texas, and Asian American girls in California, the data are not analyzed in ways that allow specific, targeted studies that can lead to change.

During the 1970s and early 1980s, federally funded projects addressed the different interest and achievement levels in science and mathematics of girls and boys. However, partly due to changes in funding priorities in the mid-1980s, many of those programs as well as the gains made by girls and women have leveled or declined. For example,

- between 1982 and 1986, the percentage of girls enrolled in high school pre-calculus and calculus declined from 45% to 39%;
- the number of college women electing computer science and engineering majors peaked in 1984 and since then has declined;
- between 1970 and 1986, the gap between 13-year-old girls and boys (favoring boys) in science proficiency scores has doubled;
- in 1993, boys won three out of every four scholarships (352 boys and 84 girls) awarded to encourage study in science, space, and technology by the National Academy for Science, Space, and Technology;
- among our mathematically gifted youth, 12% more boys than girls anticipate a college science, engineering and mathematics (SEM) major, and 22% more boys than girls subsequently enroll in one.

Today, my remarks focus on three areas: first, sex-role socialization, both in-and out-of-school, that suggests that mathematics and science are masculine activities; second, results of research studies and intervention programs for students and their teachers; and third, federal funding priorities, particularly at the National Science Foundation.

**Brief Review of School Science and Mathematics**

A general description of science and mathematics classes--from kindergarten through high school physics--suggests that girls and boys, on the whole, have very different experiences. The nature of those experiences is strongly influenced by the sex-role stereotypes that teachers may hold, that many children bring to school, and that many parents wittingly or unwittingly foster at home. Furthermore, because schools are social institutions, they reinforce behaviors, interests, and occupations that are considered appropriate for females and males. Differences in classroom interaction patterns in math and science tend to be consistent; i.e., more frequent interactions with boys, fewer challenging questions posed to girls, fewer opportunities for girls to use manipulatives or equipment, and more examples and exemplars related to masculine activities. It has been estimated that, on average, teachers spend 44% of their time with girls and 56% with boys, resulting in approximately 1800 more hours of teacher instructional time over 12 years of schooling for boys.

Pat Campbell's interviews of kindergarten children three weeks after they enter school suggest that girls and boys bring to school different ideas about science. At that age, neither boys nor girls can define science, but--even without that knowledge--more boys than girls reply that they want to be scientists, that they are good in science, and that they have done science. The importance of those attitudes is reflected in the hypothesis that sex differences in course taking patterns are established as early as kindergarten.

As early as fourth grade, girls show a preference for biological topics, while boys, many of whom have had out-of-school experiences with mechanical and electrical activities, choose topics in the physical sciences. Furthermore, girls base their selections on *what they should know*, while boys select science topics on the basis of *what they want to know*. When science curricula are based on either girls' expressed interests--or on teacher interest--they severely limit girls' education in science, eventually resulting in only 15% of girls enrolling in physics, compared to 25% of boys.

The role of teachers in influencing students' perceptions about and confidence in doing mathematics and science is evident. As a group, teachers hold stronger sex-role stereotyped views about the appropriateness of specific science activities for girls and boys than students do. The work of Jacquelynne Eccles' group in mathematics at the University of Michigan as well as that of my group in science has shown a relationship between teachers' expectations of girls and of boys and student attitudes and behaviors in math and science classes. Furthermore, most elementary teachers are women who may have chosen elementary education as their college major partly to avoid rigorous science and mathematics classes. A recent report of the National Research Council describes the woeful lack of adequate preparation in science (usually 6 to 9 undergraduate credits) and, to a lesser extent, in mathematics of elementary teachers. Initiatives such as that of the Holmes Group Consortium that require degrees in a discipline-based major for prospective teachers have acerbated the problem; for most choose majors (sociology, psychology, English) that have even fewer required courses in math and science than teaching majors do.

Attitudes affect enrollments as students proceed through school, and sex differences in the type of mathematics courses chosen begin to occur in grades eight and nine. Enrollment in algebra and, especially, geometry is critical. Interviews of over 5000 parents in Michigan reveal the effect of parental stereotypes on students' choice of math classes as well as on their opportunities for out-of-school activities. For example, parent perceptions affect girls' and boys' own perceptions of their ability and determine parent interactions with daughters and

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sons. Those differences result in more mechanical games and computers bought for, and played with, sons than daughters.

Perhaps because mathematics is considered a basic subject by both parents and teachers, both girls and boys value and have positive attitudes about the study of math. According to surveys by the National Assessment of Educational Progress (NAEP), there is little, or no, decline in girls' perceptions of the *value of a career in math* or in the *usefulness of math* between ages 9 and 17. Over 70% of 13-and 17-year-old girls and boys consistently express positive attitudes about the usefulness of math for *solving everyday problems*. Furthermore, 66% of fourth grade girls and boys think that almost *all people use mathematics in their jobs*. Studies at the University of Michigan show a positive relationship between perceived value and usefulness of a subject and student enrollment and achievement in that subject. In the last two decades, the positive attitudes of girls about the value and usefulness of mathematics has affected their course selections, eliminating sex differences in all courses except pre-calculus and calculus.

However, NAEP surveys of science have shown that girls' attitudes about and interest in science begin to decline around grade seven. For example, two-thirds of fourth grade girls and boys respond that what they learn in science classes is *useful in everyday life*. However, boys retain their positive attitudes through senior high school, while girls' perceptions of the utility of science fall by 11%. The same is true of students' responses concerning an *interest in a career in science*. Seventh grade boys and girls respond the same, but girls' responses fall below those of boys by the eleventh grade. This deterioration in attitudes is reflected in girls' enrollments in optional, high school science courses. A longitudinal study of American youth explains why girls and boys choose **not** to study mathematics or science during their senior year in high school, and the effects of both attitudes and sex-biased counseling are evident. Although the same two reasons *Do not like* and *Advised not to take* are most commonly selected by girls and boys, approximately 10% more girls than boys select those reasons for both math and science.

Although not disaggregated by sex, NAEP surveys of science since 1976 have found that minority children hold more positive attitudes about science than white students do. For example, from seventh grade through senior high school, both Hispanic and African American children *value the usefulness of what they learn in science classes* more than white children do. In addition, in comparison with white children, higher numbers of seventh grade Hispanic and African American children *expect to work in science-related fields* as adults. Likewise, more Hispanic and African American than white students believe that *what they learn in science classes is useful*. Although the findings of several independent studies suggest that coursework experiences have significant, positive effects on the math and science performance levels of racial/ethnic minorities, a systematic way to relate positive attitudes to enrollments has not been found.

Although based on limited information, sex-based differences in attitudes and interests as well as in confidence and achievement levels in school mathematics and science vary among several racial groups. For example, my work as well as that of James Campbell and Diane Pollard suggests that white females hold more sex-role stereotyped views of themselves and of science than do either African or Asian American females. Studies of Hispanic students find that for both females and males a strong, positive attitude about one's own sex role correlates with grades in science and mathematics. A study of Native American children indicates that boys' out-of-school opportunities and sex-role stereotyped course selections disadvantage Native American girls in computer science.

## Interventions that Work

Early programs, designed to intervene in a girl's choice **not** to study math and science, were funded by the Women's Educational Equity Act (US Department of Education) or by the Education and Human Resource Directorate of the National Science Foundation. Most projects addressed differences between boys and girls, and most were based on a deficient model; that is, changes were needed in girls' attitudes, interests, and confidence levels to make them similar to those of boys. Some of the most successful, such as EQUALS, FAMILY MATH, FAMILY SCIENCE, begun at the Lawrence Hall of Science, have become national programs. Others involved private groups such as the Girls Scouts or Girls, Inc. Although individual girls seem to derive immediate benefits from such programs, there have been no long-term studies of persistent gains. Furthermore, it has become increasingly evident that changes in teacher behaviors, in parental expectations, and in classroom and school climates are needed as well.

Individual researchers in both math and science have assessed differences in classroom treatment, in academic counseling, in peer and parental influence, and in sex-role socialization. As a result, we know what works for both girls and boys, who traditionally have not shown an interest in science and mathematics. In 1985, I described instructional strategies in high school biology classes that increased the number of girls (including minority girls) who continued to study science in high school and college. They included: the increased use of laboratories and discussions; teacher involvement in educational and career counseling; inquiry, creative, and basic skill activities; and field trips as well as other out-of-school science activities. A decade of follow-up work revealed that:

- rural, compared to urban and suburban, girls have the most limited information about and access to science and mathematics courses, but teachers (in this case all males) who particpated in equity education improved girls' attitudes and motivation in science;
- small learning groups (often seen as a panacea for the competitive atmosphere of many science and mathematics classrooms) are effective with girls, **only if** teachers monitor the groups for cooperation;
- content-based activities that developed spatial relationships (the only significant skill in which the scores of girls and boys differ) eliminates that difference in one semester;
- teaching behaviors, as well as attitudes and expectations can be changed with effective equity education during undergraduate teacher education programs (a superior program has been developed and institutionalized at the University of Northern Colorado);
- specific programs for teachers that include both content and equity (in its broadest context) training can change teacher expectations and behaviors as well as classroom instruction (a model program has been tested in Perth, Australia and Mt. Healthy, Ohio).

Similar research has been done in mathematics' classes. Eccles' work suggests that the increased use of cooperative, hands-on, and practical problem-solving activities improves mathematics instruction for girls and minority students. Fennema's work at the University of Wisconsin provides both instructional and curricular models for elementary mathematics, while Lappen's group at Michigan State University provides activities in spatial relationships for middle school math students. Furthermore, the proportion of girls who continue to study advanced mathematics is increased when teachers do specific compensatory activities. In fact, school science and mathematics for girls may have to provide compensatory activities to address the lack of those activities in girls' out-of-school lives.

**Support for Programs to Increase the Number of Girls and Women in Science and Mathematics**

Federal support of projects designed to either increase the numbers of girls and women in science and mathematics (intervention programs) or to analyze and alleviate differences between the sexes has been, at best, idiosyncratic. Public interest and support varies in relation to supply and demand factors, including the availability of U.S. or foreign male scientists. Program initiatives supported by Democratic administrations fall away under Republican ones and visa versa. Considering that girls and women are over 51% of our population, the only constant has been inadequate funds.

Although most federal agencies do not have programs targeted for girls and women, the National Science Foundation does. Recently it has revised and repackaged those programs to provide a more coordinated approach, yet the dollars allotted for women's programs are still far fewer than those allocated for minority programs. NSF initiatives for under-represented minorities provide coherent, long-term funding of multi-institutional or regional projects, while the awards for programs for girls and women are limited in length, scope, and budget. All federal agencies need to renew their programs for women and girls and the National Science Foundation needs to elevate its programs to be comparable in budget and scope to the ones it supports for under-represented minorities.

We have moved beyond the deficient model to identify specific types of instruction and specific kinds of science and math classrooms that benefit girls and minority boys. This information needs to be compiled and broadly disseminated to both prospective and practicing teachers. Programs need to be monitored for persistent, not immediate, gains. Critical entry points and transitions for girls need to be studied so that appropriate and effective counseling occurs. And, especially in math and science, school reform must address transforming, not reproducing, the sex-role stereotypes that students and teachers bring to school. Hungary has lead all nations in the International Association for the Evaluation of Education Achievement (IEA) in science because its girls score as well as its boys. We cannot reach Goal 4 unless deficiencies in the science and mathematics education of girls are addressed and alleviated.

Thank you, Madam Chairman, for this opportunity to testify. I will be pleased to respond to any questions that you or members of the Subcommittee might have.

# COMMONALITIES AMONG TEACHERS WHO RETAIN GIRLS IN SCIENCE

- Classrooms were attractive, well—equipped and maintained
- Used non—sexist teacher—developed instructional materials to supplement text
- Were sensitive to sexism in science: used women role models and non—sexist career information
- Presented "girl friendly science"
- Used laboratories, discussions and tests more frequently
- Were respected, recognized and supported within their community
- Participated in and encouraged students to enjoy science beyond school doors
- Emphasized careers and further education
- Instructional techniques encouraged creativity, further education and basic skill development
- Had positive attitudes and encouraged students

# *Equity Issues*

- **Access**
- **Excellence of Education**
- **Excellence of Outcomes**
- **Resources**
- **Leadership**

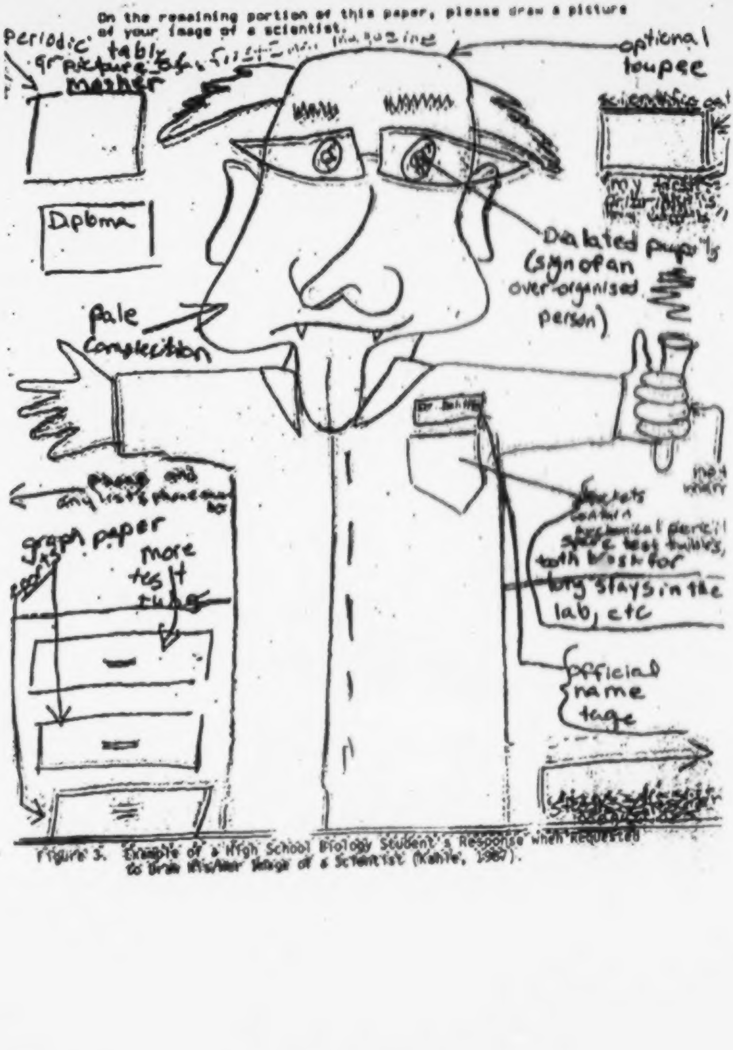
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Figure 3. Example of a High School Biology Student's Response when Requested to Draw His/Her Image of a Scientist (Kahle, 1987).

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## Closing the Gap?
## Females and Males in Science and Mathematics

- Between 1982 and 1986, the percentage of girls enrolled in high school precalculus and calculus declined from 45% to 39%.

- The number of college women electing computer science and engineering majors peaked in 1984 and since then has declined.

- Between 1970 and 1986, the gap between 13-year-old girls and boys (favoring boys) in science proficiency scores has doubled.

- In 1993, boys won three out of every four scholarships (352 boys and 84 girls) awarded to encourage study in science, space, and technology by the National Academy for Science, Space, and Technology.

- Among our mathematically gifted youth, 12% more boys than girls anticipate a college science, engineering and mathematics (SEM) major, and 22% more boys than girls subsequently enroll in one.

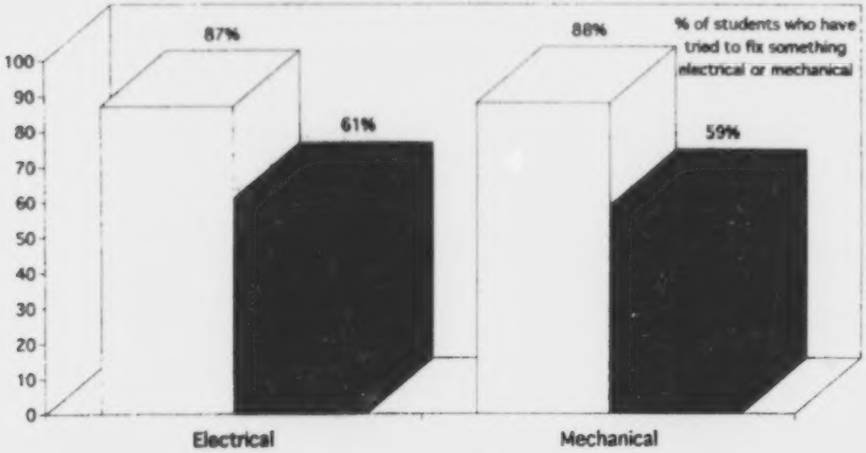
Testimony of Jane Butler Kahle, Condit Professor of Science Education, Miami University, before the Subcommittee on Energy, House Science, Space and Technology Committee, U.S. House of Representatives, June 28, 1994

## What Works? Keeping Girls in Science and Mathematics

- Teachers (in this case all males) who particpated in equity education improved rural girls' attitudes about and motivation in science.
- Small learning groups are effective with girls only if science and mathematics teachers monitor the groups for cooperation.
- Content-based activities that developed spatial relationships eliminate the difference between girls' and boys' scores in one semester.
- Sex-role stereotyped behaviors, attitudes and expectations are changed by effective equity education in undergraduate teacher education programs .
- Programs for practicing teachers that include both content and equity training can change teacher expectations and behaviors as well as classroom instruction in science and mathematics.

Testimony of Jane Butler Kahle, Condit Professor of Science Education, Miami University, before the Subcommittee on Energy, House Science, Space and Technology Committee, U.S. House of Representatives, June 28, 1994

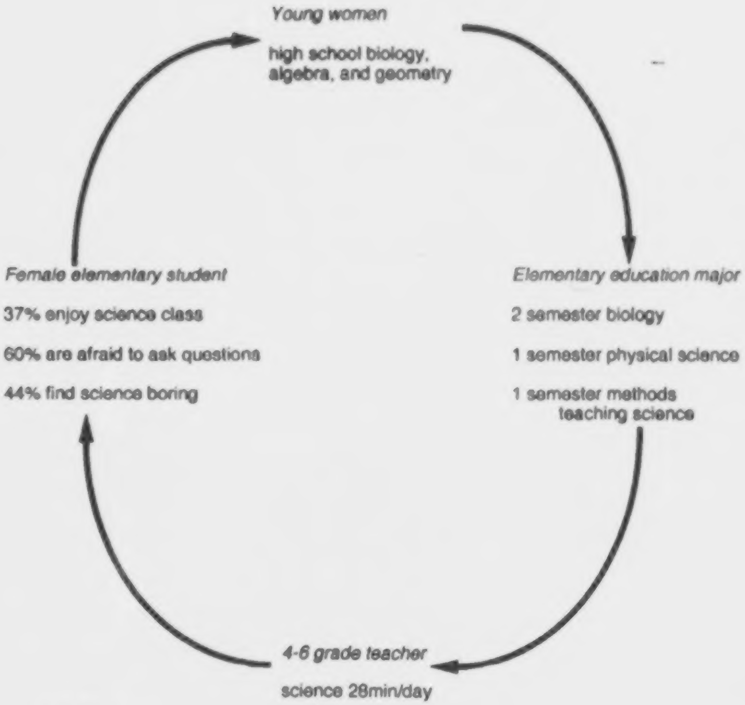
# Applications of Science Knowledge
# Electrical/Mechanical, Grade 7



Source: Horizon Research, Inc.
Tabulations of 1988 NAEP data

Science and Mathematics Education Briefing Book ©
Horizon Research, Inc., Chapel Hill, NC 8/89

## Cycle Of Selection



*Young women*

high school biology, algebra, and geometry

*Elementary education major*

2 semester biology

1 semester physical science

1 semester methods teaching science

*4-6 grade teacher*

science 28min/day

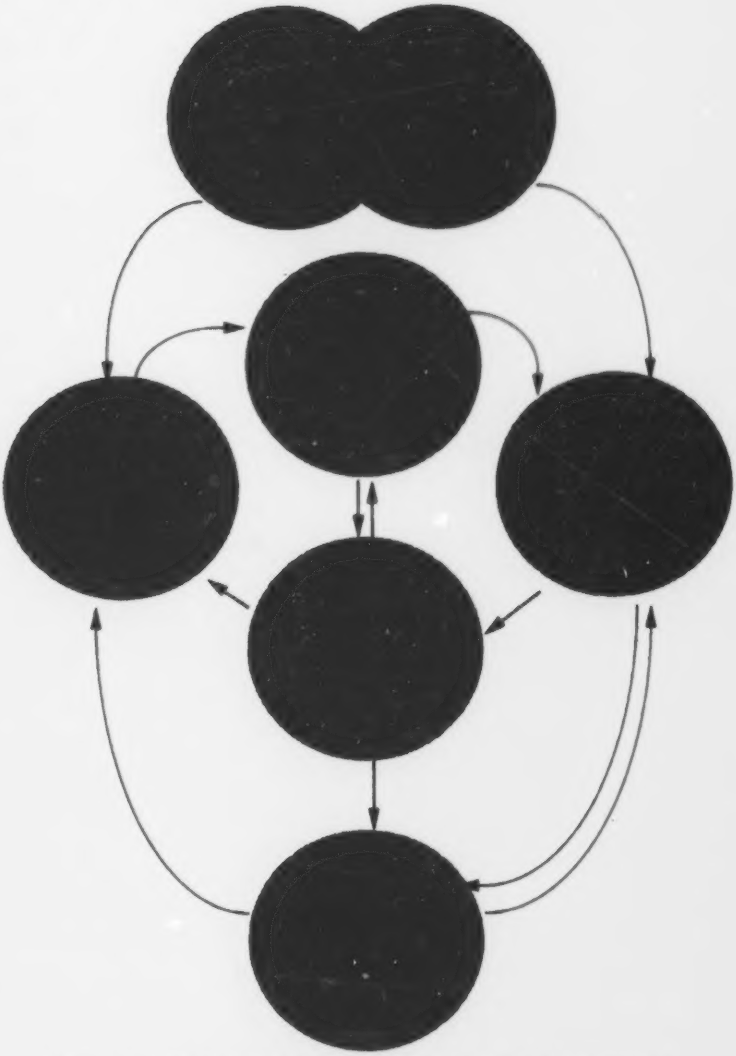
*Female elementary student*

37% enjoy science class

60% are afraid to ask questions

44% find science boring

J. B. Kahle



Source: Kahle, J.B., Parker, L.H., Rennie, L.J., & Riley, D. (in press). Gender differences in science education: Building a model. Educational Psychologist.

Mrs. LLOYD. I want to thank you, and I want to thank all the men and women that are here today to take part in this very startling hearing. In my 20 years, I don't think I have heard anything that has moved me as much as the hearing today.

And I think it is something we must address as a Nation. The Congress must address it. I am sorry we don't have more cameras in here today to really carry this message out to America. But I hope it is just the beginning, that we can work on this to create a greater national awareness of the needs to correct this problem and to really create an awareness of the problem in our country. Because certainly we are going to pay the price, when it is 51 percent of our population, the bright women that we certainly will lose in our workforce. We will certainly pay heavily in so many ways.

Before I begin my questioning, I would like to recognize Mr. Scott and Ms. Eshoo and Mr. Schiff for any comments they have to make at this time.

Mr. Scott? Ms. Eshoo?

Ms. ESHOO. I would, and I will be brief, Madam Chairwoman.

First, I would like to thank you and salute you for your leadership on this. You are going to be sorely missed in the Congress. Often the number 435 is battered about, and what is lost is what each individual, what one human being can do. And I think that today is yet another sterling example of your leadership. And I thank you, and we should all be grateful to you.

And to the Doctors at the table and everyone that is here today, you are most welcome. It isn't very often that we have panels that are dominated by women. I was so struck by that when I came to the Congress last year. I thought, Where are the women in this? They are not at our table and they are not testifying.

You have given extraordinary testimony today, and what I would like to go back to—well, maybe we can ask questions afterwards.

Mrs. LLOYD. That will be fine. Then I will come back to you.

Ms. ESHOO. And I would like to submit something for the record in terms of an opening comment.

Mrs. LLOYD. Without objection.

Ms. ESHOO. Thank you.

Mrs. LLOYD. Mr. Schiff?

Mr. SCHIFF. Thank you, Madam Chair.

Just briefly, listening to the testimony, I remember back about 20 years ago I was an assistant district attorney in the Albuquerque area and my next—office mate was a woman assistant district attorney who at that time 20 years ago quipped that her father said, "Saying my daughter the lawyer is a little like saying my son the nurse."

And although this doesn't apply directly to science, it makes the same point. It makes the same point that gender stereotypes were alive and well 20 years ago. I hope they have evaporated a great deal since then. But I believe the problem is still pervasive, as the witnesses have said.

The other item I want to say is in 1980 I became the district attorney of that office and I always felt that I got a lot of talent that corporate law firms and to some extent government law firms weren't willing to accept. I still remember that four of my attorneys had the given name Kathleen, three had the given name Mary, and two had the given name Susan. So, I was very happy to get talent that I think was unfortunately and unfairly passed up elsewhere. But I put it to good use in our office.

I thank you for holding this hearing, Madam Chairman, and I yield back.

Mrs. LLOYD. Thank you for being here. I appreciate it very much.

Mr. Scott?

Mr. SCOTT. I am not going to be able to stay for questions, I have another conflict. I just want to make one—

Mrs. LLOYD. Please go ahead. I am going to recognize you and Ms. Eshoo and then Mr. Schiff for questions you have.

Mr. SCOTT. Just a quick comment. I also serve on the Education and Labor Committee, and some of the comments that have been made about how you can kind of gradually, not intentionally, but kind of have people drift off course and not get their full potentials is one of the problems we are dealing with in Education and Labor with minority students, with female students, and the kind of, I guess, techniques and technology we have, and teaching teachers how to teach to make sure that they don't succumb to that stereotyping, I think is very important. And not just women in science but also all kinds of education with minorities.

I appreciate the testimony, too.

Mrs. LLOYD. Thank you very much.

Ms. Eshoo?

Ms. ESHOO. Thank you. I would like to pursue something that is absolutely fascinating to me, Dr. Kahle, that you underscored in your testimony, and that was that minority girls were far more open or flexible to science and math issues. Can you elaborate on that and perhaps tell me what the underpinning is for that?

I really am—I mean I am delighted. But I would have never guessed that.

Ms. KAHLE. Yes. And obviously, my frustration about the data is that it is just based on individual studies, not large databases. We think it will be there.

The difference seems to be that, if I put the shoe on the other foot, that white majority girls carry much heavier loads of sex role stereotyping from their home. That many minority girls are expected to achieve as well, to do as well, in science and math as their brothers.

So, it is a great deal of the home influence that we are seeing here, because we see it as low as fourth grade.

We also see much more active participation in science, for some reason. The work I did was with African American children and those girls were active, engaged, and they didn't think it was unfeminine to be competing with both white and African American boys.

When we look at data we actually come up with two groups of children in achievement and in interest in these studies. Majority boys, minority boys and minority girls form one group, and the white girls form a separate group.

The same is true in Jim Campbell's work with Asian girls. Using the highest talent, the Westinghouse Science Talent Search winners, where again they separate out Asian boys, white boys, Asian girls, and as a separate group white girls. And it has to do with the issues of risk-taking, being willing to take risks, being competitive, and also simply assuming that it is an appropriate activity for you within your own culture.

It is very devastating data. The more we see the more clear it becomes. It is pervasive.

Ms. ESHOO. Thank you. Perhaps the reason I picked up on that is because I was recalling what my teachers told me. And they said it is far too difficult. You won't be able to do it, so don't take these classes. And I believed them, of course. I mean they were the authority figures in my life and we accepted what the teachers told us and that was that.

And now I am on the Science, Space and Technology Committee of the House of Representatives of the United States of America.

Can either one of you comment on the progress that the National Science Foundation has made? Last year in their testimony before our committee I pursued these issues with them and what their policies were and how many more women they were—what policies they had to bring more women in and have them participate in the highest quarters of our Nation, and also to expand women scientists' role on our National Science Board. They are the ones that make the recommendation.

Of course, we pursued that with the White House as well, and I think that we have gotten their attention. There are more openings, and I have submitted names of women working with AWIS on this, who have been just absolutely terrific because of all the resources that they have gathered.

Can you comment on that, or give us any kind of direction on it?

Ms. KAHLE. I—as Madam Chairman said, I chaired the Committee on Equal Opportunities in Science and Engineering for NSF and I think there has been great progress. Shirley Malcom, who will be testifying soon, of course, is on the National Science Board. They did redo the women's programs and make them much more focused and much more of a systemic or systematic way of approaching the issue.

My concern remains, however, that they are still a minor amount of the total budget in NSF. But it is important to remember that NSF has not only targeted programs but also nontargeted programs. In other words, my work would be funded through regular programs. Other women researchers are funded through the normal directorates. I shouldn't say the normal directorates. The nontargeted directorates.

So, I think there has been progress with the targeted programs, and there certainly is increasingly good data that women are filling roles of principal investigators, that they are being funded at rates comparable to male.

In fact, we looked at some of these data last Friday and the only thing interesting or different still is that women tend to ask for fewer dollars than their men counterparts do, so we still have slightly less funding. But some of it is because we are more modest or need fewer dishwashers in our laboratories.

Ms. ESHOO. Aren't we something?

May I ask one more question.

Mrs. LLOYD. Yes, please. One question.

Ms. ESHOO. Dr. Bailey, is there—I believe—let me just preface my question with a comment.

I believe that before the long reach of the arm of the Federal Government gets into our local communities that we can do some things there representing these districts. And I am looking to put something together locally that will reshape how our teachers teach with the Community Foundation and hopefully through some of the school boards.

Do you know of any kind of a primer or something that has been put together that would help instruct them in this area, so that as we teach them then they can teach better?

Ms. BAILEY. There are a variety of models for teacher training and in-service faculty development that would be useful, I think. We have just published a report at the Center that pulls together a lot of strategies that can be helpfully used by teachers.

I think one of the most important things is a training model that allows teachers to talk about what they are doing successfully, because I think all too often teachers are doing some wonderful things but they assume that, you know, well, that is just what I do in my classroom and that wouldn't be worth sharing.

Ms. ESHOO. This is very typical of women.

Ms. BAILEY. Yes.

Ms. ESHOO. To say.

Ms. BAILEY. And I believe that we need to encourage teachers who are doing innovative things to keep some data on that, keep some record and to share that with other teachers, because some of the best practices and the most successful ones, I believe, grow out of the classroom and the experience that teachers themselves have.

Ms. ESHOO. Well, we will be in touch with you to see if we can't use some of the great things that you have put together.

I want to thank you, and I couldn't mean that more. Your research and what you know and what you are doing are really the tools that we need to start turning this around.

And I think—just for the few moments that I have been in the hearing room, I think of the girls that are losing and that, you know, hopefully, with what our outstanding chairwoman has put together today and the direction, the guidance that you are giving us that we will make good use of it, and that we can, hopefully, by the end of my service in the Congress, however long that might—maybe it will be short, but that we will make great progress. Let me put it that way. So, thank you to you.

Mrs. LLOYD. As most of you know, this is my last year. But this issue is not going to go away. It is going to be one that I am going to continue give much attention to the rest of this year. And I am going to leave it in good hands with Ms. Eshoo and, hopefully, Mr. Schiff, for next year.

Mr. Schiff, do you have any comments you would like to make?

Mr. SCHIFF. No. I just want to say I appreciate the testimony of the witnesses. Thank you very much.

Mrs. LLOYD. I am going to follow up on Ms. Eshoo's last question. You have given us a wealth of material here that we need to go with, not only to create a greater awareness of a very bad situation and one that is harming our Nation, but where do you think we should go to really bring about change in our educational system?

Ms. KAHLE. I think you have to very directly affect the teaching force. It takes too long if you only start with the preservice people, the undergraduates, and clearly the type of thing you are thinking about, directly going to the practicing teachers. Now one of the things I have found most successful with practicing teachers, teachers don't deliberately disadvantage children but it happens. I can go in and document it happening. I can also teach them or you can teach them, or someone can teach them, how to begin documenting those interaction patterns in their own classrooms.

And, if they are too busy teaching, children love to do this documentation. You have to realize that it is happening within your own situation before you begin to make change, otherwise it is always Mr. Stout down the hall who does those things in physics, not Ms. Butler in biology. So, I think that is a piece that we have to begin with.

And, of course, if we begin with practicing teachers, you have huge numbers you could affect very quickly. NSF has the statewide systemic initiatives now and the urban systemic initiatives that are large projects. They are being very proactive about equity in those projects and those projects, to me, promise a way to reach many teachers much more quickly than we have been able to in the past.

Mrs. LLOYD. How effective are the programs outside of the classroom to increase girls' exposure to science and math? Do you have any documentation on that, Dr. Bailey?

Ms. BAILEY. Yes. I think there are some wonderful programs outside of school, and I think that we can learn a lot from the programs that the Girl Scouts, Girls, Incorporated, for example, just to name a couple, are doing.

I think what we need to do when we look at those programs is think about the fact that girls don't have to attend those programs. They go to them because they want to. And so those programs have found ways to interest students and to keep them interested.

I think we need to look at what they are doing and try to find ways to incorporate more of those out-of-school experiences into classroom situations, because not every girl has an opportunity to take part in an out-of-school activity, and girls spend a lot more time in school than they do in those out-of-school activities.

Mrs. LLOYD. How about the program such as the one-day programs for teacher enrichment or special exposure for the children?

Ms. KAHLE. Unless there is some consistency, some follow-up, those programs are almost all throwaways, I am sorry to say. There is very good data that you have to have follow-up.

Ms. BAILEY. I think that there is a tendency for people to feel—I mean many people from school systems have told me this. Oh, we don't need to do anything on this this year. We did it 5 years ago. And a 1-day session for 3 hours in the afternoon every 5 years certainly doesn't do it.

In fact, unfortunately, I think what it sometimes does is give people the feeling that they have done something about it. They have come to a meeting and they have listened, and that means they have done something.

I think that every time people are together, school people, PTA people, school board people, parents, there needs to be a strong emphasis on, Okay, what is the next thing you are going to do before you get out of this conference or this session or this training? What is the next thing so that the people don't feel that they have taken care of that now they can go on to something else. And it is a long-term process.

Mrs. LLOYD. Dr. Bailey, you mentioned that we do not have all the data we need for a full comparison of socioeconomic variances. Is this significant at this time? Or would you like to comment further on—

Ms. BAILEY. Well, I think that as Jane also indicated, we simply don't have enough data to let us look at different groups of girls and boys, and what is happening to them.

And the assumption that all girls are the same is no more accurate than the assumption that all students are the same. And I think that we do need to pay some attention to these differences—Jane discussed several of them—because that makes a difference in how we are approaching the school systems where those girls are.

It makes a difference in the messages that we give to parents, and I think that without that information we can make too generalized a statement that may apply, in fact, actually to no one because it supposedly applies to every one. So we have to be careful, I think.

Mrs. LLOYD. You want to comment on that Dr. Kahle?

Ms. KAHLE. Yes, because it is very important to understand individually we don't have enough data but there are national databases that are coded so that that information can be retrieved. It is simply that the analyses are not run, which is my plea at the beginning of my statement.

The data are coded by socioeconomic level, by region of the country, by sex, and by race, and the information released is not—does not ever include sex other than all girls and all boys.

Mrs. LLOYD. I have one final question. Your opinion of single sex classes or schools, girls schools. How effective is this?

Ms. KAHLE. In the longer paper, I have what I consider the results of a very interesting and maybe one of the most definitive studies. It was, again, done at the University of Michigan by Valerie Lee. She looked at 21 schools. They were all private schools, so she could even out socioeconomic level: 7 all girls, 7 all boys, and 7 coeducational. And she found sexism in all of the types of schools. The most overt sexism was in boys schools where there were frequent comments about girls. The coeducational schools, the most prevalent sexism was in chemistry classes. She studied English, history, math and chemistry. And although there was sexism, it was shared between teachers and students, and a lower percentage coming from teachers in all male or all female schools.

Female schools she characterized as having a pervasive form of sexism, or pernicious form, because it was a sexism that said, "Oh, that is all right. You don't need to do this. Or if that is too hard, you don't need to try this".

So, it was more of a nurturing atmosphere than a challenging atmosphere which my colleagues who teach at single sex girls schools say girls do have in their classes and do bring to school with them.

It was absolutely fascinating that none of the types of schools got off the hook. Single sex classes in public schools are being tried now, although the question of their legality is still out. Girls tend to like them because they have more of their friends in these classes. Teachers love them because they are extremely well behaved.

The only problem is the teachers who get the all boy classes are not very happy, and the boys don't really like writing their own reports. So it is not a highly popular choice among the boys and some of the teachers.

Ms. **BAILEY**. I would just like to add that I agree with Jane's point that any classroom, be it mixed sex or single sex, can be less than adequate for the students in it and that you can have sexism in an all girl's classroom.

I do think that we need—

Mrs. **LLOYD**. What you are trying to tell me, though is, it is the degree of challenge that the teacher gives the student. How is girl-girl, boy-boy?

Ms. **BAILEY**. Well, I think, yes, the expectations that are held, but also I think we need to look carefully at what is going on in mixed sex classrooms where the decision then is that somehow we do better if we separate the students. Because often what underlies that is the boys are causing a problem so we will take the girls out.

I am concerned about the message that that sends to girls that somehow they are the ones that need the special help. I think we need to think about managing the classrooms in a way that all of the students in them, girls and boys, get an opportunity to both speak, take part and to listen, as I mentioned earlier.

It is too easy, I think, to just jump to the idea that a single sex classroom will solve the problem. At the same time it is clear that for many girls a single sex experience particularly in the areas of math and science is a positive one. So, I think we need to look carefully.

Researchers always think there should be more research, but I think we need to look carefully at what's going on in those classrooms that works well and then think about doing more of it in the mixed sex classrooms.

Mrs. **LLOYD**. I have a 12-year-old granddaughter that makes straight A's that is not the least bit challenged. And the reason I am asking this question, I am going to help my daughter to enroll her into a private girls' school. Not because it is a girls' school but it is a school where she will be challenged.

And I was thinking myself when I was asking some of these questions, but of course not all little girls are as fortunate as she is going to be, and I am concerned about all of our young women as well. But she needs to be challenged to do more.

Ms. **BAILEY**. Well, I think all students need to be challenged, and we have a situation, unfortunately, where indeed many are not and many of the least challenged are girls because the expectation is—

Mrs. **LLOYD**. My granddaughter is being teased—now, I think it is a form of harassment—at the school where she is now, because they make fun of her because she is smart and she studies.

Ms. **BAILEY**. If you talk to adolescent girls an awful lot of them already tell you that one of the things that they like best about being in a single sex, all girl environment is that then they don't have to be afraid to be smart. They don't get teased for it.

Mrs. **Lloyd**. That is a problem that we have encountered. Because if they make fun of the girls they intimidate the girls when they study, then the normal change is, Well, let's just don't do so much of that.

Ms. **Bailey**. Right. And one of the pieces of data that was in my report that I thought was taking a little too long to go through every chart was that it is very disturbing to see that where the science gap between boys and girls is widening is among the top scoring students.

So, we are seeing a greater difference between the science scores and achievement of the brightest students with girls doing less well and boys doing better, and I think that part of these expectations and the harassment and the teasing that goes on plays into that.

And that is particularly troublesome when you look also at the mathematics in an eighth grade among the top students the gender gap in math is also increasing, and that is right at that junior high level. So there is definitely a problem.

Mrs. **Lloyd**. Right where they need it the most.

Ms. **Bailey**. Yes.

Ms. **Kahle**. Could I add something in here because I—

Mrs. **Lloyd**. Yes, you may.

Ms. **Kahle**. I just got this information. But we all know that recently there was "Take Our Daughters To Work" Day, and in some places, for equity, this became "Take Our Sons And Daughters To Work" Day. And I have a report from BP America in Houston, and they report that 83 children between 8 and 14 participated.

And when they had the boys and girls together in a small room where both girls and boys were present at the videoconference sessions, the boys dominated the sessions. They did most of the talking and took ownership of the video control box. And they took the seats first when it was clear that there were only seats for a small number of children.

We also noted that during the girls wrap-up sessions that the girls who came to the microphone and asked questions were generally in the 8 to 11-year-old group. The older girls did not participate.

They are similar to girls in adolescence beginning to lose their confidence and their participation declined. So it is not just in school. It has to be very carefully monitored in all aspects, I think, of a girl's life.

Mrs. **Lloyd**. Well, I certainly thank you for your testimony.

Mr. Baker, do you have anything more?

We hope that we can make a wave and certainly implement some changes. Thank you very much for being here.

Ms. **Bailey**. Thank you.

Ms. **Kahle**. Thank you.

Mrs. **Lloyd**. Our second panel includes Dr. Shirley Malcom, Head of Directorate for Education and Human Resources Program, American Association for the Advancement of Science; Richard Stephens, Director, Office of University and Science Education Program, Department of Energy; Jane—Dr. Jane Stutsman, Deputy Assistant Director, Directorate of Education and Human Resources, National Science Foundation—I certainly will be directing some questions to you that have been brought up; Stacy Kass, Director of Careers and Life Planning, Girls, Incorporated; and Dr. Rebecca Failor, Member of Board of Directors, Math/Science Network in Oakland, California.

We do have your testimony. We thank you so much for being here and participating. You may submit your statement for the record and you may summarize it as you wish.

And, Dr. Malcom, we look forward to your testimony at this time.

**STATEMENTS OF SHIRLEY MALCOM, Ph.D., HEAD, DIRECTORATE FOR EDUCATION AND HUMAN RESOURCES PROGRAM, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, WASHINGTON, D.C.; RICHARD E. STEPHENS, DIRECTOR, OFFICE OF UNIVERSITY AND SCIENCE EDUCATION PROGRAM, U.S. DEPARTMENT OF ENERGY, WASHINGTON, D.C.; JANE STUTSMAN, Ph.D., DEPUTY ASSISTANT DIRECTOR, DIRECTORATE OF EDUCATION AND HUMAN RESOURCES, NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C.; STACY KASS, DIRECTOR OF CAREERS AND LIFE PLANNING, GIRLS, INCORPORATED, NEW YORK, NEW YORK; REBECCA FAILOR, Ph.D., MEMBER OF BOARD OF DIRECTORS, MATH/SCIENCE NETWORK, OAKLAND, CALIFORNIA**

Ms. MALCOM. Thank you very much. Thank you, Madam Chair, and to members of the committee, for the opportunity to testify.

I will summarize in such a way that I basically deal not only with the subject of my testimony but also with some of the other aspects of the AAAS programs for which I have responsibility.

It just so happens that in my work at AAAS I have responsibility not only for the informal programs such as the Girls in Science Program that I discussed in my testimony, but also for the formal education programs and for programs for the public understanding of science and technology.

And I believe that that is important because there is a central idea that I think that we have to convey that the life spaces of girls are continuous. That while we might, in fact, look at what happens in their K-12 experience in their school experience that, in fact, we have to effect not only what is happening in their classroom situations but in their out-of-class experiences as well, and that some of the programs that we undertake to bring science, quality science and mathematics into their out-of-school lives are exceedingly important. They play a crucial role, especially in terms of providing some of those experiences that we say early on we can tell the difference between boys and girls' achievements in science largely because of differences in those early experiences.

So, what we are saying is that here is an opportunity utilizing the format of community-based organizations and the different existing infrastructure of the organizations in which girls participate, can't we utilize those in order to provide a quality science and mathematics experience? And that is really what the Girls in Science Program is all about.

Within our directorate at AAAS we have a number of programs where we have essentially put all of the pieces together, and that is where we have taken a communitywide approach that deals not only with what is happening outside of the school and not only at targeting groups that are under-represented, but also in terms of looking at how we can support in-school reform and how we can provide parents with the kind of information that they need in a timely fashion so that they can affect what happens with regard to their children and what happens to them in a school setting.

There is nothing wrong with the girls. I think that that is the message that we have heard here. There is absolutely nothing wrong with the girls. Oftentimes there are things wrong—there is a lot wrong with the way that we approach them. There is a lot wrong with the kinds of programs that we might offer to them. In many cases there is a lot wrong with the fact that we don't challenge them enough and have high enough expectations for them.

That is why we have to worry about and make sure that we can support standards-based reform because the groups who could likely benefit most from having clear expectations and high expectations are those who have had in so many cases such low expectations. We have built on the work of the Girls in Science Program that we have carried out under the AAAS auspices and under Bush Foundation support, and we anticipate that these kinds of quality out-of-school experiences do have a role in overall reform.

We expect that in some cases, especially with the elementary girls, they are actually receiving more time on science and math than they are likely getting from their K-12 experiences, because there is so little that is now being provided for children at the elementary level.

Again, I appreciate the opportunity to come and provide some information and insight about the program of which we are so proud because it is an opportunity to reconnect science, math and technology to the lives of girls and young women.

[The prepared statement of Ms. Malcom follows:]

TESTIMONY BY

DR. SHIRLEY M. MALCOM

HEAD, DIRECTORATE FOR EDUCATION AND HUMAN RESOURCES PROGRAMS
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SUBMITTED TO

SUBCOMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,

U.S. HOUSE OF REPRESENTATIVES

28 JUNE 1994

It was over 18 years ago that I first appeared before a committee of the U.S. Congress to testify about issues related to women in science and engineering. During those intervening years we have made progress; we have seen increases in women's participation in science and engineering careers and in Ph.Ds earned in S/E fields. (See attached paper by Betty Vetter prepared for Science Linkages in the Community). But 18 years later we find ourselves discussing many of the same concerns about gender differences in science and mathematics coursetaking, achievement, experiences, and access to quality programs. Why has this happened? Why, after so many years, do the problems described in the AAUW report, and in the report by these witnesses still persist in science and mathematics education?

I was among those advocates for increased science and mathematics coursetaking in high school by minority and young women students. If these students would only realize the connection between the amount of mathematics and science and their access to college majors or to adult careers, we thought, then things would be different. We did get improvement and more coursetaking, but nothing was really "fixed". As we looked inside many of those classes that we urged young women to take we became increasingly aware of the unevenness of curriculum quality, of uninspiring pedagogy and topics, and a competitive environment which neither encouraged participation nor communicated an accurate picture of the way science is really practiced. We pushed our interventions down in the grades to middle school as we recognized that for so many young women the damage had already been done: at the first point that science and mathematic courses became elective they would opt out of the talent pool.

While most students (girls and boys alike) were not receiving much science at all as part of their elementary school experiences we came to understand all too well that this disadvantage girls more since their lives outside of school were less likely to include science, mathematics and technology, since they played different games, were provided different toys and had different experiences available to them.

We came to understand that we had to look at all of the life spaces of girls and young women, at the messages that they were receiving about science and mathematics from the home, from school, from their community and in the larger society. And we began, along with many other groups, to build interventions to address some of these problems. We knew from The National Assessment of Educational Progress and from the work of researchers such as Jane Kahle, Jacqueline Eccles and others that girls had less access even to simple technology, measuring equipment and instrumentation and that much of this differential came from leisure time and non - school uses; that girls had less encouragement from their parents to do mathematics and science since they too had been socialized to think that boys were better at these fields.

As we looked around for interventions to address these non - school hours (community opportunities for science and mathematics and parental attitudes and beliefs) we turned to some natural partners: youth serving groups and other community - based organizations (CBOs) committed to the education and social development of young people especially those who were members of minority groups, girls or those with disabilities. The crucial role of CBOs in the development of early adolescents is fully explored in the report of the Carnegie Task Force on Early Adolescents: A Matter of Time. Beginning around 1985 with support from Carnegie Corporation of New York we developed a project, Linkages, to formally connect CBOs to science - based organizations. We worked with Girls, Inc in their Operation SMART (Science, Mathematics and Relevant Technology) serving in consultative roles on content and intervention strategies.

Through support of the Bush Foundation of St. Paul we developed the program "Girl and Science: Linkages for the Future," working with the 14 local Girl Scout Councils that serve the tri - state area of Minnesota, North Dakota and South Dakota. The director of this program was Marsha Matyas, then director of the AAAS Project on Women in Science, now Education Officer of the American Physiological Society.

The goals of the project were varied:

- to develop quality hands - on science experiences; a training manual with accessible language and activities using inexpensive, easily located materials to allow girls ages 5 to 17 to explore science and technology concepts and to complete science - based badges.

- to help council staff and trainers develop confidence and skills in facilitating the work of leaders around science and technology themes.

- to identify local scientists and engineers who could serve as role models and as long term advisors to the work of local councils.

- to provide opportunities for girls to use the kind of equipment and to engage in the types of activities that studies indicate can foster long-term interest in science, mathematics and engineering, such activities which girls often have minimal opportunities to explore.

A subsequent project also supported by Bush Foundation, "In Touch with Technology," built on the success of the first project and provided experiences to explore more advanced topics in the physical sciences, engineering and computing. Kits were provided to the councils that included the more technical equipment necessary to successfully complete this program.

This "trainer of trainer" model is highly effective in promoting "scale - up" (increasing the number of people trained and the number served) as well as in building local capacity to to undertake science, mathematics, and technology based activities.

For example in the "Girls and Science: In Touch with Technology" project AAAS staff trained some 35 experienced trainers and council staff not only to carry out activities we had developed, but also to adapt activities from other sources. These trainers and staff members subsequently trained between 800 and 1,000 leaders who served 8 to 10 thousand girls and young women. Since capacity exists within those communities these trainers and leaders can continue to serve the girls who enter scouting.

More than 550 institutions, businesses, government agencies and individual women scientists, mathematicians and engineers volunteered to participate as resource people to these councils. These community resource listings were published by AAAS and made available to the councils.

There were many other results from this program:

- development of quality hands - on materials and training approaches which have been made available to other councils as well as used in regular teacher inservice programs.
- development of a newsletter, activity postcards and patches to provide information, enhancement and identification with the project.
- based on a prior relationship begun with Black Hills Girl Scout Council, the establishment of Rapid City, S.D. as site of a community - wide comprehensive reform effort, part of the AAAS Science Linkages in the Community initiative supported by Dewitt Wallace - Readers Digest Fund.

We know that our Girls in Science project is only a small part of what needs to be done to connect girls, young women and the adults who work with them to science, mathematics and technology education. But this project fills an important need for girls and young women using the existing infrastructure of youth-serving groups to build confidence, a base of experience and success, support for local reform and help in affecting parent attitudes about the role of science and technology in their daughters' lives.

At AAAS we have incorporated the lessons learned and tools developed into our programming including our more comprehensive community - wide activities.

We understand that the entire system of K-12 education in science and mathematics must change - that teachers must teach all students well, that the classroom environment must support all children's learning, that all students must be provided quality preparation in challenging subject matter and then held to high standards; that the modes of instruction must be varied and supportive of girls' and boys' interests; that the forms of assessment must support development of problem framing, problem solving and critical thinking for girls and boys; that schools must be organized to affirm and support science and mathematics learning for all.

But we also must realize that most schools only last from September to June; most students are at home and in their communities between 3:30 p.m. and 8:30 a.m. Monday - Friday and all day from Friday afternoon to Monday morning. There need to be quality science, mathematics, technology experiences available for girls there as well. Programs offered by CBO's can help fill these spaces. And so can quality programs on radio and television, quality books and software.

"Girls and Science" is one of many interventions we have developed and programs we undertake to fill the life spaces of girls and young women. We want to help them connect to science and technology and have these fields affirmed as having a role in their lives and in their future.

Attachment to Testimony of Shirley M. Malcom
Submitted to Subcommittee on Science, Space, & Technology
U.S. House of Representatives
[illegible] June 1994

# STATUS OF WOMEN SCIENTISTS & ENGINEERS IN THE UNITED STATES

Prepared by
Betty M. Vetter, Executive Director
Commission on Professionals in Science and Technology
1500 Massachusetts Avenue, N.W., Suite 831, Washington D.C. 20005

under contract with

American Association for the Advancement of Science
Science Linkages in the Community Project
1333 H Street, N.W., Washington D.C. 20005

February, 1994

## INTRODUCTION

Throughout most of its history, science in the United States has been principally an enterprise of white males. In recent years, the policy of open doors to foreign graduate students has brought many Asian students here to earn their doctorates, and many of them have stayed, becoming a part of the United States workforce in science. A few hardy women made their way into science early in the twentieth century, but the great depression of the thirties, World War II and its G.I. Bill in the forties, and the general tenor of the culture in the fifties all combined to erect barriers to women which relatively few women were able to surmount.

Prior to the 1970s, a tiny handful of African Americans managed to earn degrees in science, often from one of the historically black colleges or universities established after the Civil War to maintain segregation of the races while providing education for a few middle-class African Americans. A majority of these graduates found employment in these same institutions.

Mexican Americans typically dropped out of school earlier than other Americans, and relatively few Puerto Ricans earned college degrees, either in Puerto Rico or in mainland universities. There was little encouragement in the school system for Hispanic citizens to enter higher education, and even less encouragement for them to enter science. Most Cuban Americans earned their college degrees before coming to the United States, but even among these immigrants, relatively few had advanced degrees in science.

The opportunities for American Indians to learn about and prepare for science careers were almost non-existent before mid-century, and rare after that. Organizations such as AISES (American Indian Science and Engineering Society), NSBE (National Society of Black Engineers) and SHPE (Society of Hispanic Professional Engineers), and student organizations or programs such as NAMEPA (National Association of Minority Engineering Program Administrators, NACME (National Action Council for Minorities in Engineering), WEPAN (Women Engineering Program Administrators Network), MESA (Mathematics, Engineering, Science Achievement) and GEM (Graduate Education for Minorities in Engineering) were all founded less than two decades ago.

Scientists with disabilities were almost universally scientists whose training and early experience had preceeded the disability, since there were few opportunities for mainstream education of children with disabilities.

The progress of the past two decades is remarkable for all of these groups—minority and white women, African Americans, Hispanic Americans, American Indians and Americans with disabilities. But none of them are yet on a level playing field with white males, either in opportunities for preparation for a science or engineering career or in opportunities for employment and advancement. This series of status reports is designed to shed some light on the accomplishments of and the remaining barriers to each of these groups in attaining an appropriate partnership in the American science enterprise.

## INTRODUCTION

During the 1970's and early 1980's, American women made remarkable inroads into the community of scientists and engineers. However, the increase in their participation has leveled off in most areas, although they have not yet achieved demographic parity or occupational equality with men. Some of the barriers to their participation are dropping, and others are at least being recognized —the first step toward their elimination.

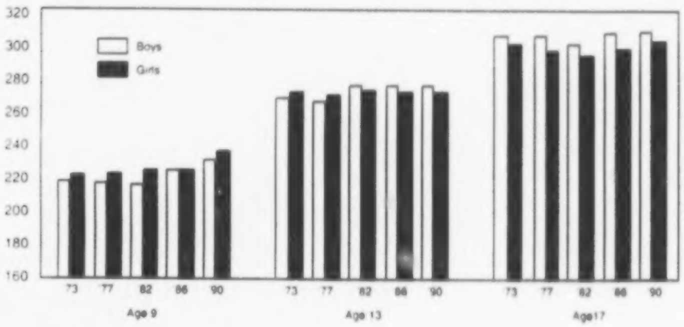
Girls are drawn toward or pushed away from science and mathematics not only by their own aptitudes and interests, but also by their reactions to the attitudes of their teachers, their parents, and their peers. Society tends to believe that boys are more likely than girls to be adept at mathematical or mechanical activities. This is among the many damaging stereotypes that affect American children and the choices they make, both in school and later during their working years.

Because of this stereotype, boys and men are far more likely than girls and women to believe they are good in mathematics and science, even when their grades are the same, or lower. This difference in self-confidence is not an accident, nor is it the result of genetic differences. It comes, instead, from societal conditioning, so that boys grow up believing they are superior to girls in mathematics and science, even when their grades say otherwise.

## THE SCHOOL YEARS

Mathematics is the most important single factor in determining admission and success in science and engineering careers, and girls score as well as boys through theearly teen years. However, with little to encourage their participation, many girls drop out of mathematics as soon as they can, and this lowers their scores by age 17.[2] In the most recent national assessment in 1990, young women show some improvement relative

TRENDS IN MATHEMATICS PROFICIENCY BY SEX AND AGE, 1973–1990



SOURCE NAEP

Graph by CPST (266A PMW)

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Clifford Adelman, Women at Thirtysomething: Paradoxes of Attainment, Washington, DC: U.S. Department of Education Office of Educational Research and Development, 1991

Ina V.S. Mullis, John A. Dossey, Eugene H. Owen and Gary W. Phillips, The State of Mathematics Achievement, Educational Testing Service for National Center for Education Statistics, (Report No. 21-ST-03), Washington, DC: Government Printing Office, June 1991

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to the men in the age 17 group, as mathematics course taking for girls again comes into favor.

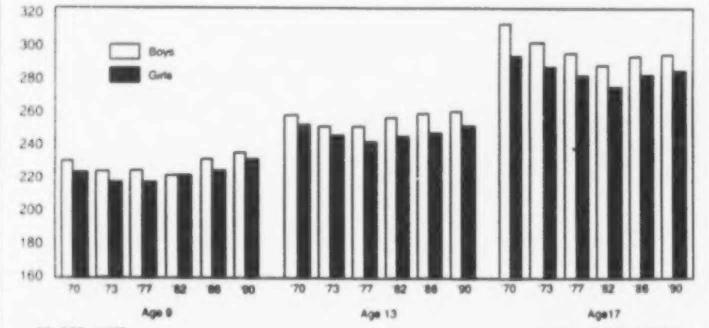
Science is a different matter. The NAEP science assessment shows a sex gap even at age nine, and widens at each higher age as girls drop farther behind boys—scoring 3.5 percent below them by 1990.[3] Among the reasons for this are:

Most K-8 teachers, almost all women, suffer from inadequate preparation in science so that they fear teaching science and lack confidence in their ability to do it effectively.[4] The role model relationship is obvious. A teacher's fear of or feeling of helplessness with science or mathematics says to the girls that it is natural for them not to like or be good at these subjects.

Teachers of all ages and both sexes discriminate in the classroom.[5] They, with the rest of society, have lower expectations for girls than for boys, particularly in science and mathematics. They call on and praise boys more than girls, let boys interrupt girls, but praise girls for being polite and waiting their turn.[6] Although some barriers are being broken, and genuine change is occurring, both overt and insidious forms of gender bias continue to distort the education of American girls and young women, from kindergarten through graduate school. Sexual harassment now starts in grade school, with taunts, physical touching, and grabbing. School officials have failed to stop this behavior.[7]

By the time they are sophomores, only ten percent of the girls compared with one-fourth of the boys express interest in the natural sciences. By the end of high school, about one fifth of the boys, but only one twentieth of the girls continue to indicate a potential career interest in these fields.[8]

**TRENDS IN SCIENCE PROFICIENCY BY SEX AND AGE, 1973–1990**



SOURCE: NAEP

Graph by CPST (2008 PMW)

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[3] Ina V.S. Mullis and Lynn B. Jenkins. The Science Report Card: Elements of Risk and Recovery. Princeton NJ: Educational Testing Service, September 1988 and National Assessment of Educational Progress. NAEP 1990 Technical Report. Princeton, NJ: Educational Testing Service 1991.

[4] Iris Weiss. Science and Mathematics Education Briefing Book. Vol. IV. Chapel Hill, NC: Horizon Research, Inc., 1993.

[5] Myra and David Sadker. Failing at Fairness: How America's Schools Cheat Girls. New York: Charles Scribner's Sons, 1994.

[6] J.S. Eccles and J.E. Jacobs. "Social Forces Shape Math Attitudes and Performance." SIGNS, 11, 367-380, 1986.

[7] American Association of University Women. Hostile Hallways: The AAUW Survey on Sexual Harassment in America's Schools. Washington D.C., 1993.

[8] Bassam Shakhashiri. "U.S. Science Education," in Human Resources in Science and Technology: Improving U.S. Competitiveness. pp. 59-69. Washington DC: Commission on Professionals in Science and Technology 1990.

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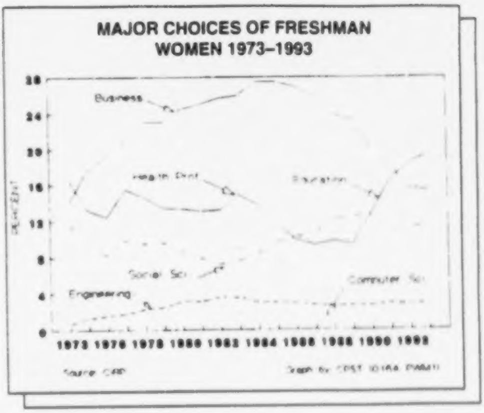
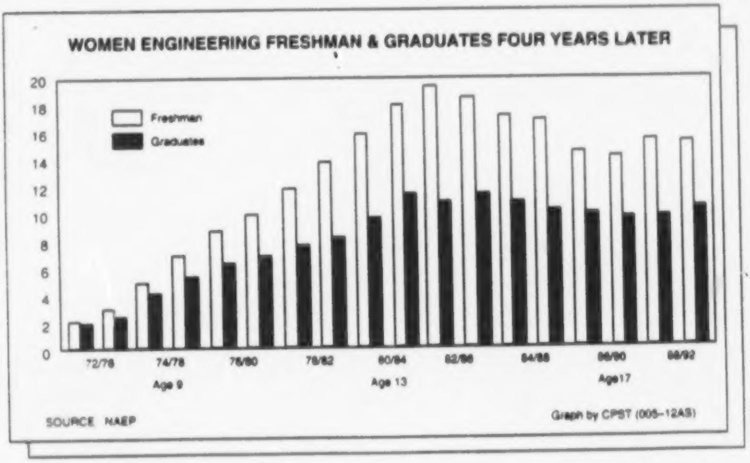
## UNDERGRADUATES

Over the past two decades, there has been a significant increase in the proportion of American women who go to college after high school graduation, and their participation in mathematics-based major fields has increased generally in proportion to their greater college attendance.[1]



But the forces that turn women away from science and engineering do not vanish at the end of high school. Among those hardy women who enter college planning to major in engineering, for example, more than one third apparently do not complete those plans, if we compare freshman



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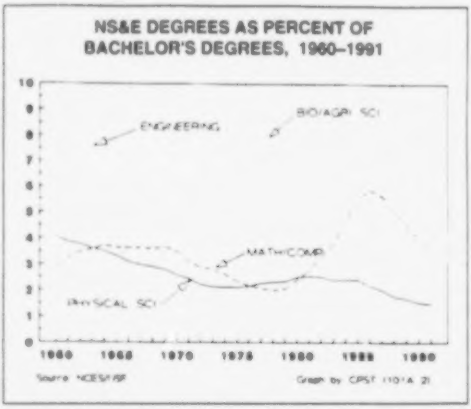
[1] National Center for Education Statistics, Series of Earned Degrees Conferred by Institutions of Higher Education, 1950-91, reported in Professional Women and Minorities: A Total Human Resource Data Compendium, 11th Edition, pp. 66-68. Washington DC: Commission on Professionals in Science and Technology, 1994.

enrollments with graduations for that class.

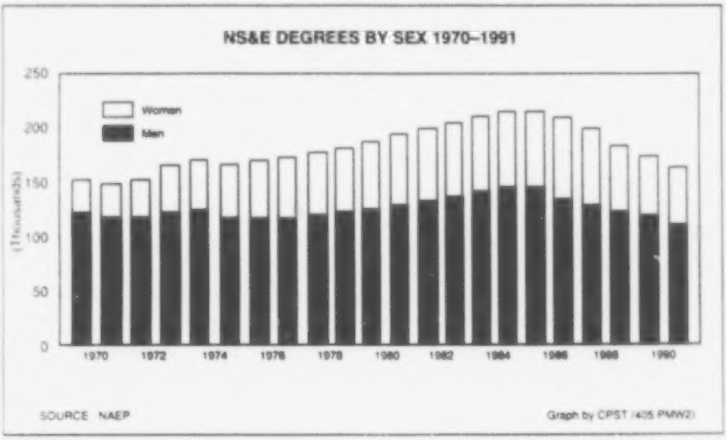

NS&E DEGREES AS PERCENT OF BACHELOR'S DEGREES, 1960–1991

Source NCES/IPF

Graph by CPST (101A 2)

We do not know whether those who leave engineering move to other majors, in or out of the science/engineering grouping, change schools, or drop out of school altogether. One ongoing study of undergraduate majors in science and engineering[10] finds that the students who continue in the science or engineering major differ very little from those who move out of the field before completing a degree. They have the same complaints about the undergraduate program, but the student who leaves is more likely to be drawn away by another force, such as peer pressure or interest in another major. Relatively few women students leave engineering because of bad grades.

Despite the substantial drop in the number of college age Americans that began in the early 1980s, there has been no drop in total baccalaureate production, and none is expected before


NS&E DEGREES BY SEX 1970–1991

SOURCE NAEP

Graph by CPST (405 PMW2)

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Nancy M. Hewitt and Elaine Seymour, Factors Contributing to High Attrition Rates among Science, Mathematics and Engineering Undergraduate Majors, Report to the Alfred P. Sloan Foundation. Boulder, CO: University of Colorado, 1991.

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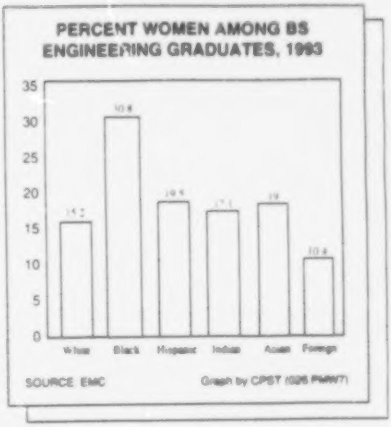
1994.[11] However, the number of bachelor's degrees awarded in the natural sciences and engineering has been dropping, for both men and women, from a high of 214,000 in 1986 to 160,600 in 1991 -- a 25 percent drop in just five years.[12]

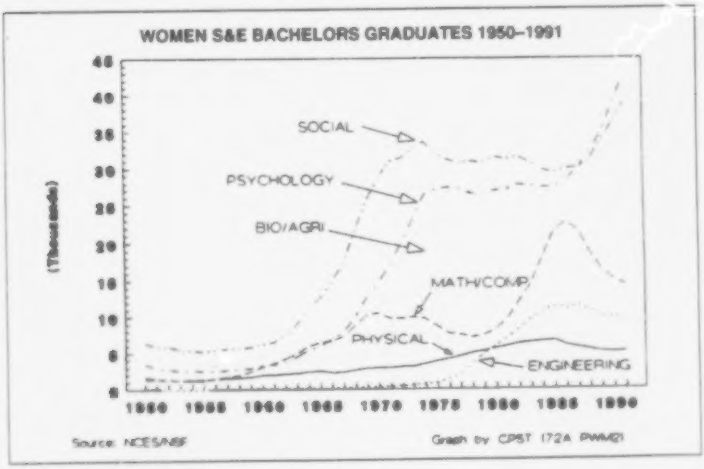
Thus, as a percentage of all bachelor's degrees, those in the natural science and engineering fields have dropped from 21.3 percent in 1986 to 14.7 percent in 1991. Had it not been for the increasing numbers of women earning these degrees during the decade of the 1980s, degrees in these fields by 1991 would be at about the same level as in 1971.

For women, the number of bachelor's degrees that are in natural science and engineering fields has fallen from 12.3 percent in 1986 to 9.1 percent in 1991, while the numbers in social and behavioral sciences have risen steadily. Except in the bio-sciences, women have not achieved


PERCENT WOMEN AMONG BS ENGINEERING GRADUATES, 1993

SOURCE: EMC

Graph by CPST (026 PMW7)


WOMEN S&E BACHELORS GRADUATES 1950–1991

Source: NCES/NSF

Graph by CPST (72A PWM2)

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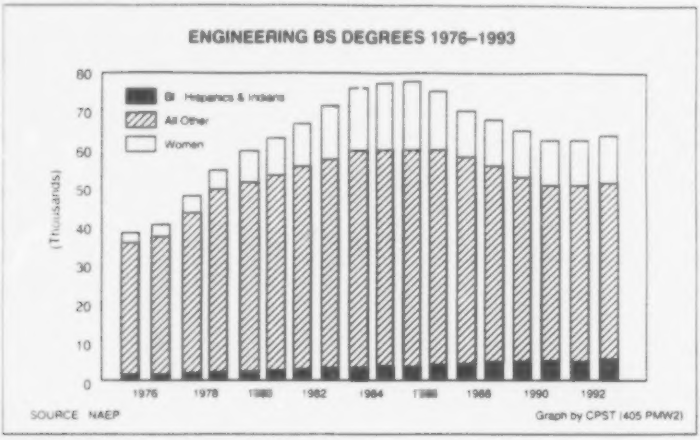
National Center for Education Statistics, Projections of Education Statistics to 2002: An Update (NCES 91-683), Table C14.

Betty M. Vetter, Ed., Professional Women and Minorities: A Human Resource Data Compendium, Washington DC: Commission on Professionals in Science and Technology, 1994. Table 2-19, p. 68.



ENGINEERING BS DEGREES 1976–1993

SOURCE NAEP

Graph by CPST (405 PMW2)

parity even at the bachelor's level in any of the natural science fields, although they now earn more than half of all bachelor's and master's degrees awarded, and almost 40 percent of the PhDs. They earn only 33 percent of the natural science and engineering bachelor's degrees, 27 percent of the master's and 22 percent of the PhDs. The behavioral and social sciences raise the percentages.

In engineering, women rose from less than 2 percent to almost 15 percent of the BS graduates from 1976 to 1986, but then held steady for the next six years. Finally, in 1993, they increased their share of BS graduates to 16.1 percent.

At the bottom of each bar in this chart are the combined black, Hispanic, and American Indian graduates of both sexes. Separating the data by both sex and race, we find that women earn a higher percentage of the engineering degrees awarded to minorities than of those earned by white students. Black women, particularly, earn about twice the percentage of black degree awards as do women of other racial and ethnic groups. The foreign graduates show the smallest representation of women.

## GRADUATE STUDY

Graduate enrollment in the sciences and engineering has risen steadily since 1974, largely fuelled by foreign students, who now make up 30.1 percent of full time enrollment. In fall 1991, women were 37.1 percent of all full time graduate students, ranging from 13.7 percent in engineering to 66.4 percent in psychology. There are 24 percent of full time students in the physical sciences; 30 percent in the mathematical sciences as well as in the earth, atmospheric, and ocean sciences; 31 percent in the agricultural sciences; 21 percent in computer sciences (down from 25 percent in 1982); 45 percent in the biosciences; and 41 percent in the social sciences.[11]

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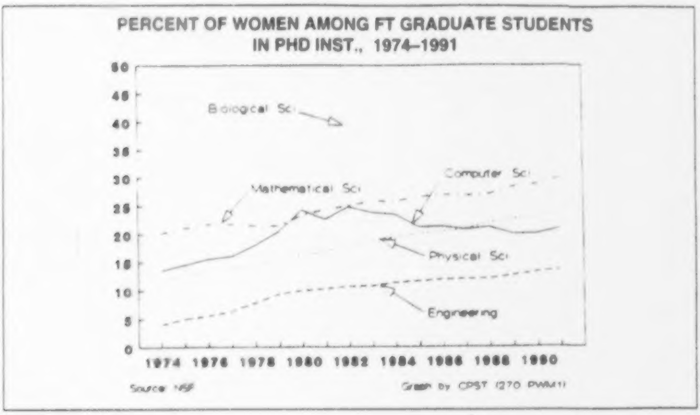
[11] National Science Foundation, Selected Data on Graduate Students and Postdoctorates in Science and Engineering: Fall 1991, Specialized Pamphlets No. 5: Sex, and No. 7: Citizenship (NSF 92-335.5 and 92-335.7)



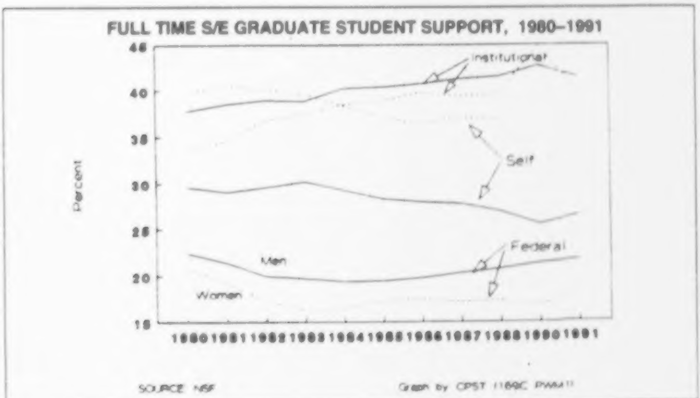
PERCENT OF WOMEN AMONG FT GRADUATE STUDENTS IN PHD INST., 1974–1991

Source: NSF

Graph by CPST (270 PWM1)

**Financial Support**

Although the majority of graduate students in the math-based fields are supported during their graduate years, women are more likely than men to have to support themselves, and are much less likely than men in the same fields to obtain federal support for graduate study. In 1990, for the first time, they had more institutional support than men (usually teaching assistantships) but by fall 1991, a higher percentage of men than of women had institutional support. Men also are more likely than women to get their support in

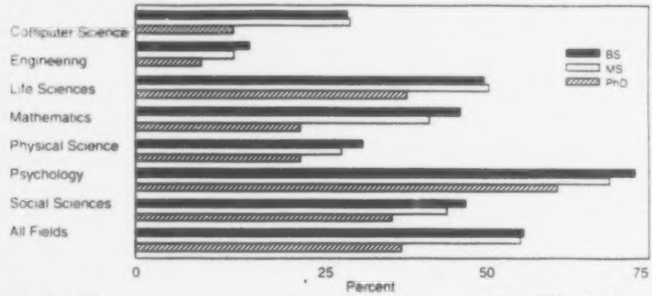


FULL TIME S/E GRADUATE STUDENT SUPPORT, 1980–1991

SOURCE: NSF

Graph by CPST (1169C PWM1)

PERCENT OF S/E DEGREES EARNED BY WOMEN, 1991



Source: NCES

Graph by CPST (437 PWM2)

the form of research, rather than teaching assistantships, thus furthering their opportunities for a research career.

## GRADUATE DEGREES

Women are more likely than men to seek a master's degree without planning to continue further graduate study. They are 47 percent of all full time science and engineering graduate students in masters-granting institutions, but only 32 percent of those in PhD-granting institutions. Continuing lack of self-confidence appears to be one reason for this discrepancy, and lack of support may be another.

Women earn a slightly lower percentage of master's degrees in the natural science fields than of bachelor's degrees, with the largest drop occurring at the PhD level. The number of women earning doctorates in science and engineering defines the baseline for their presence among top researchers and faculty. In most of the math-based fields, those numbers continue to be well under one fourth of the total.

With a steady increase since 1970, women now earn about one third of the life and social science doctorates, and exceed half only in psychology.[14] Looking only at U.S. citizens, women earned 26.3 percent of 1992 doctorates in natural science and engineering fields, or 2,483 (of 9,428) U.S. awards, including 281 in engineering, 86 in physics and astronomy, 356 in chemistry, 140 in earth, atmospheric and marine sciences, 97 in mathematics and 69 in computer science.

Within this group of women, 11 were American Indians, 143 were Asian Americans, 35 were African Americans, and 71 were Hispanic, for a total minority representation of 11.3 percent.

In contrast, 7,857 foreign citizens, mostly male, earned PhDs in these same fields in 1992 from American universities. Women are better represented among doctorate recipients in the life sciences, the social sciences, and the behavioral sciences — all fields with small foreign representation.

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[14] National Research Council. Summary Report 1992: Doctorate Recipients from United States Universities. Washington DC: National Academy Press. Series, 1972-93.

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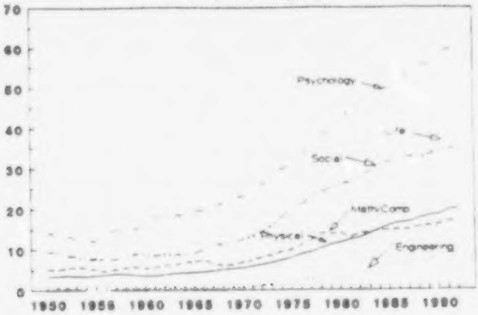
PERCENT OF WOMEN S/E PHDS BY FIELD, 1950–1992
(3–year averages)



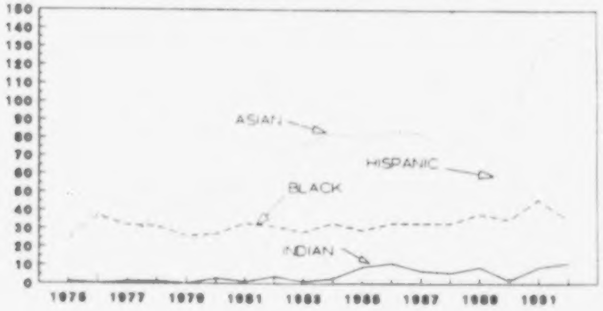
Source NCES/NRC

Graph by CPST (303 PWM2)

## WOMEN IN THE WORKFORCE

With growing numbers of women prepared for the professional workforce, their presence is increasing in all science and engineering fields. Although still under 10 percent of the engineering workforce, they make up one fourth and more of the working science population, including more than half of the psychologists and the social scientists and urban planners, according to the U.S. Department of Labor. However, few

NS&E MINORITY PHD WOMEN, 1975–1992



Source NRC/NSF

Graph by CPST (063 2)

women are working in the top echelons of business, industry or government; and academic women still advance in rank well behind the men with whom they graduate.

**Unemployment Rates**

Particularly at the doctoral level, women do not appear to have an equal opportunity to obtain employment. Women in science are more than twice as likely to report being unemployed and seeking employment as are men with similar credentials. In spite of a relatively low unemployment rate among doctoral scientists and engineers, the unemployment rates in every biennial survey of the doctoral population over the past 16 years have been two to five times higher for women than for men in the same doctoral field.[15] When overall unemployment is highest, the gap between the unemployment rates of men and women is greatest.

**Salary Differentials**

A major barrier to women is differential salaries, including the statement this makes. In a democracy, salaries generally are equated with worth. Like men, women need to be assured that society values their abilities, their work, and their achievements. Many things affect salary, including amount of education, field of specialization, years of experience, type and size of employer, and geographic location; as well as shortage or surplus of workers with similar qualifications. But when all of those have been controlled, the differential that remains is related to the sex of the worker.

Although women earn less than the men with whom they work, women college graduates working in a field strongly dominated by men, such as engineering, will earn more than women working in a female-dominated field such as elementary education, because fields dominated by women are assumed to be worth less than those dominated by men. This has little or

**EMPLOYMENT IN SELECTED OCCUPATIONS, BY SEX, 1992**

**(Numbers in Thousands)**

| Occupation | Total Employed | Percent Women |
|---|---|---|
| Total, 16 years and over | 117,598 | 45.7 |
| Managerial and Professional Specialty | 31,153 | 47.3 |
| Executive, administrative, and managerial | 14,767 | 41.5 |
| Officials, administrative, public admin. | 619 | 43.8 |
| Accountants and auditors | 1,365 | 51.2 |
| Professional specialty | 16,386 | 52.6 |
| Architects | 138 | 15.3 |
| Engineers | 1,751 | 8.5 |
| Mathematical & computer scientists | 935 | 33.5 |
| Computer systems analysts & scientists | 693 | 29.6 |
| Operations & sys. researchers & analysts | 192 | 45.2 |
| Natural scientists | 459 | 27.2 |
| Chemists, except biochemists | 120 | 30.1 |
| Geologists and geodesists | 52 | 11.8 |
| Biological and life scientists | 95 | 33.8 |
| Health diagnosing occupations | 914 | 18.3 |
| Physicians | 614 | 20.4 |
| Dentists | 162 | 8.5 |
| Health assessment & treating occupations | 2,517 | 86.8 |
| Teachers, college and university | 737 | 40.9 |
| Teachers, except college and university | 4,216 | 74.8 |
| Social scientists & urban planners | 387 | 54.1 |
| Economists | 122 | 43.3 |
| Psychologists | 223 | 62.5 |
| Lawyers and judges | 788 | 21.4 |
| Lawyers | 753 | 21.4 |

*Source: Employment & Earnings, Jan. 1993, US Dept. of Labor* nothing to do with the level of demand for such workers, the level of responsibility required for the job, or of any shortage or surplus of supply. And even in female-dominated fields, men are paid more than women, from the very beginning. For example, 1993 starting salary offers to new baccalaureate graduates in nursing averaged $36,964 for men; $31,594 for women.[16]

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[15] National Science Foundation, Characteristics of Doctoral Scientists and Engineers in the United States, biennial series, 1972-1989

This occupational wage or salary differential, determined by the proportion of women in the field, explains why, among all full time workers, women with four or more years of college in 1990 earned average salaries ($28,017) nearer to those earned by men with only a high school diploma ($26,653) than to those earned by men with a bachelor's degree ($39,238).[17]

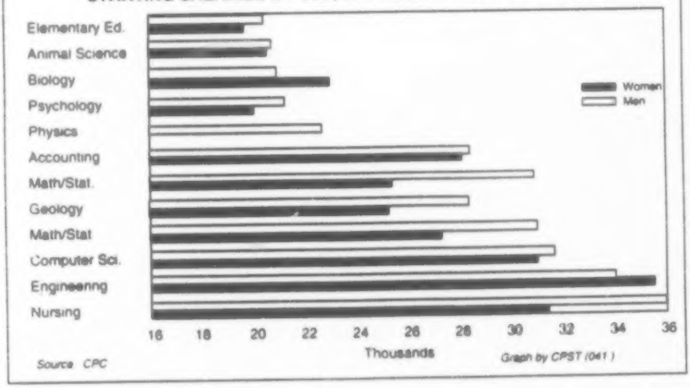
Starting salaries in most fields are slightly lower for women than for men,[18] and the gap widens over time. Some years, women in one field or another will show higher average offers than the men with whom they graduated, as in biology in 1993, but by the next year, women will once again have slipped behind their male cohorts.

Engineering is an exception. Here women have received slightly higher starting salaries than men for several years, but that advantage quickly disappears as men are promoted faster than the women with whom they were hired. In the words of a recent study by the Society of Women Engineers, "Before they reach the age of 30, men engineers move ahead of women and continue to move ahead throughout their careers."[19]

Doctoral scientists and engineers show the salary gap beginning with the very first job, and the gap continues to widen over time. Particularly at the point about 20-24 years after the PhD, women's salaries drop off, while men's continue to rise.[20]

The overall salary gap between men and women doctoral scientists in 1991 is about $12,000 per

**STARTING SALARIES BY SEX, BACHELORS GRADUATES, 1993**



Source CPC

Graph by CPST (041)

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[16] College Placement Council, Survey of Starting Salaries, 1993, Final Report, July 1993.

[17] Bureau of the Census, Series P-60, No. 174, 1992.

[18] College Placement Council Quarterly Surveys of Salary Offers to New Graduates.

[19] Society of Women Engineers, A National Survey of Women and Men Engineers: A Study of the Members of 22 Engineering Societies. New York, NY, 1993.

[20] National Science Foundation, Characteristics of Doctoral Scientists and Engineers, 1991. In press.

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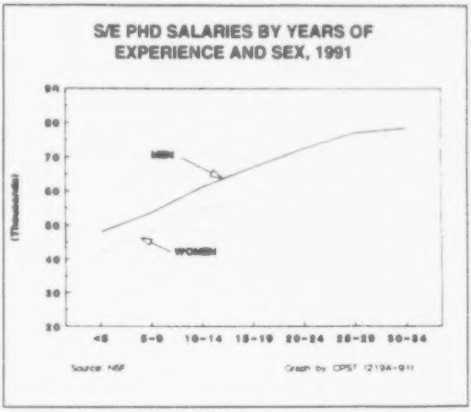
year, but is less in some fields than in others, and is less among those with comparable experience levels.

Women scientists are hurt by the salary differential. They pay the same fees and tuition as their male classmates while in school; and they pay the same prices as men for food, mortgage loans, cars, and all other essential goods and services. The salary difference among PhDs extends across all science fields, and has changed very little over the ten biennial surveys of the doctoral population that have been carried out by the National Research Council since 1973.[21]


S/E PHD SALARIES BY YEARS OF EXPERIENCE AND SEX, 1991

Source: NSF
Graph by CPST (2194-91)

**Sexual Harassment**

A major barrier to advancement is sexual harassment and outright sexual discrimination. Women scientist groups report that this problem is a continuing one. As was evident to all after the televised nomination hearings of Supreme Court Justice Clarence Thomas, men and women do not necessarily see the same thing when they examine sexual harassment or other forms of workplace bias. Several recent studies demonstrate that this is still true.[22]

**The Glass Ceiling**

Like women in every profession, women in science are limited in how far they can rise. Less than 3 percent of top jobs at Fortune 500 companies were held by women in 1990; only 175 or 2.6 percent of the 6,502 corporate officers employed at the nation's largest companies in 1992 were women; only 4.5 percent of the corporate board seats of the Fortune 500 companies were held by women.[23]

**Women in Government**

Federal agencies employ a higher percentage of women among scientists and engineers than either industry or academe. However, as in other settings, entry level sare lower and advancement is slower for women. Grade levels (and thus salaries and responsibility) lag well behind men of similar background. Federal women scientists, wherever employed, typically are two or more salary grades below men in the same field, with a salary differential of $6,000-$12,000.[24] While some of this may be attributed to greater job longevity among men, that is not sufficient to explain the difference.

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[21] National Science Foundation, Characteristics of Doctoral Scientists and Engineers in the United States: 1973 through 1989, op. cit.

[22] For example, Richard B. Primack and Virginia O. O'Leary, "Women in Ecology," BIOSCIENCE, March, 1993; Ellis and Eng, op. cit.; Nina Roscher, Women Chemists 1990. Washington DC: American Chemical Society, December 1990; and Russell Reynolds Associates, Men, Women and Leadership in the American Corporation, New York, November, 1990.

[23] Study by the Feminist Majority, reported by Karen Ball in "Study Finds Few Women Hold Top Executive Jobs," THE WASHINGTON POST, August 26, 1991, p. A-11.

[24] Eleanor Babco, Ed., Salaries of Scientists, Engineers and Technicians, 16th Edition. Washington DC: Commission on Professionals in Science and Technology, Aug. 1993, pp. 161-166.

**Women in Industry**

Companies have double standards for men and women, so that women and their contributions are perceived differently than their male colleagues. For example, companies often reward men and penalize women for the same action, whether it is parenthood or leadership. Having children indicates stability in male employees, but lack of dedication to the job for women. A confident women is likely to be considered "too aggressive." Women are promoted only after they have already proven that they can perform the tasks required in a new position, whereas men are promoted based on their perceived potential. Women are excluded from the men's networks, but may be discouraged from setting up support groups of their own.[25]

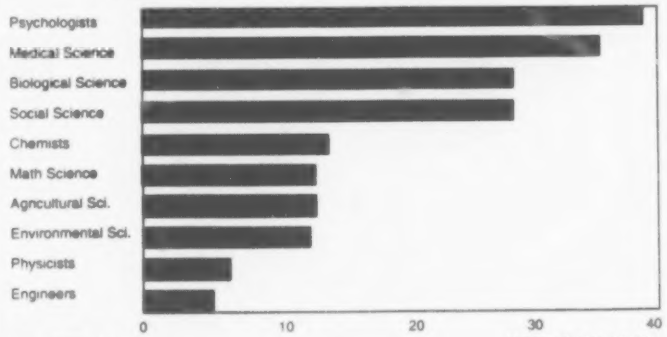
**Women in Academe**

The percentage of employed PhD scientists who are women more than doubled from 10 percent in 1973 to 22 percent in 1991.[26] Women make up about one third of all working scientists, and have been available in larger numbers for many years in the lower and middle ranks of science. But they have been unable to pierce the upper scientist strata in anything beyond token numbers.

Among doctoral scientists employed in academic institutions, women earn less than men at every rank, in every type of institution, and in every field. It is also more difficult for women to find employment in academic institutions, particularly in tenure track slots; to achieve tenure when they do receive academic appointments, and to advance in rank. Despite large inroads into academe, women are not yet represented on tenured or tenure track faculty in proportion to their availability. For example:

•In the top ten departments of mathematics in the U.S., there were 303 tenured men and four women in 1993. Harvard, MIT, Princeton, Yale, Stanford, California Institute of Technology, and Chicago had no tenured female faculty. UC-Berkeley had two, but was being sued (successfully) for sexism by Jenny Harrison, who had been denied tenure.[27] Women earned 22 percent of math PhDs in 1992, so the persistence

**WOMEN AS PERCENT OF EMPLOYED S/E PHDS, 1991**



Source: NSF

Graph by CPST (354 PWM4)

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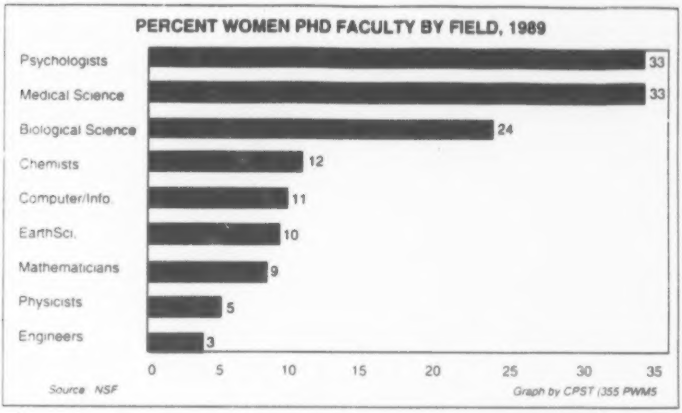
[25] Linda Dix, Ed., Women Scientists and Engineers in Industry: Why So Few? Washington D.C.: Committee on Women in Science and Engineering, National Research Council. National Academy Press, 1993.

[26] National Science Foundation, Characteristics of Doctoral Scientists and Engineers in the United States, 1991, op. cit.

[27] Reported in MANPOWER COMMENTS, v. 30, No. 5, July/August 1991, p. 20.

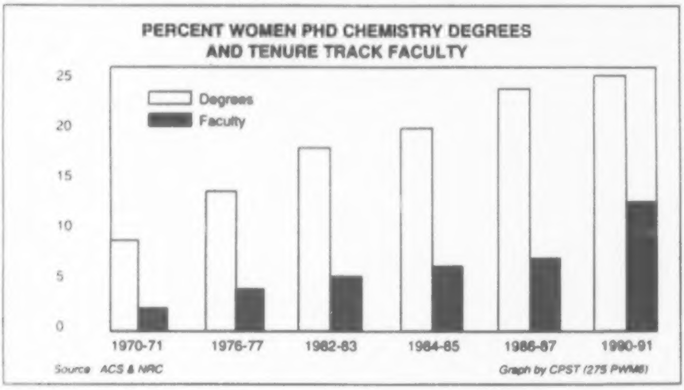

PERCENT WOMEN PHD FACULTY BY FIELD, 1989

Source NSF

Graph by CPST (355 PWM5

of such imbalance within mathematics faculties suggests the continued existence of a bias against women in many top-level mathematics departments.

- The picture in chemistry is similar. Women have earned an increasing percentage of the doctoral awards in chemistry every year since 1960, (including more than one fourth of 1992 awards), but they made up only 5 percent of tenured faculty in 1991 and 16 percent of tenure track faculty, although they have earned 9-25 percent of the chemistry PhDs awarded by


PERCENT WOMEN PHD CHEMISTRY DEGREES AND TENURE TRACK FACULTY

Source ACS & NRC

Graph by CPST (275 PWM6)

these same institutions in every year for the past two decades. Doctoral women chemists in academic institutions earn substantially lower salaries than their male counterparts with the same rank—i.e. $6,500 less among full professors in 1990, $2,926 less among associate professors, and $1,873 less among assistant professors.[28] These differences exist regardless of experience level, e.g., among full professors 20-24 years after the BS, men average $65,675; women, $61,868.[29]

## SUMMARY AND CONCLUSIONS

Women have increased their presence less in the physical sciences and engineering than in most professional occupations. Perhaps because of their small representation, they appear to have made less progress in removing the impediments that continue to restrict their advancement among their peers than is true for women in the social sciences, in medicine, in law, and in general business careers -- all of which include higher proportions of women. Relative to men with similar credentials and experience levels, women in all of the sciences earn lower salaries, experience higher unemployment rates, are more likely to be employed in temporary positions, and find fewer and slower opportunities to advance, either in rank or toward management, or to obtain security in the form of tenure.

The barriers of social prejudice and custom that impede progress for women in science have not been removed, although some of them are slowly being edged aside. The isolation experienced by women working in engineering and science has decreased as more women enter these fields.

Societal mythologies about gender-based characteristics of girls and women and their appropriate roles are slow to change, but they are changing. Most American families now recognize the importance of preparing their daughters for independence, rather than solely for marriage and motherhood.

The next step, already slowly underway, will be to equalize the playing field to take full advantage of the talent and training of that half of the U.S. population who are women.

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[28] American Chemical Society, Domestic Status, Discrimination, and Career Opportunities of Men and Women Chemists. Washington D.C.: American Chemical Society, October 1992.

[29] Roscher, op. cit., Table 4.18.

Mrs. LLOYD. Well, thank you very much.

Mr. Stephens, we are going to have to break for two votes here. I apologize for the inconvenience, but I am sure you know that is the way it works around here.

[Recess].

Mrs. LLOYD. Well, thank you for your patience. We apologize for the delay.

And, Mr. Stephens, we look forward to your testimony at this time.

Mr. STEPHENS. Thank you, Madam Chair. Actually, I should give you some reason why I am actually here today. It turns out that I am the father of four daughters. And listening to the testimony earlier this afternoon, I can share many personal experiences.

I had four daughters who left sixth grade moving into middle school excited about science. Two of them were turned off immediately by their middle school science teacher. The other two maintained an interest in science but were counseled out, again, of taking the tough courses at the high school level. You had to continually fight to keep them in against the advice of teachers and counselors. So, I can share many of those same kinds of experiences on a personal level we heard about earlier this afternoon.

The other reason is that I have been before this committee before and I am also retiring at the end of September. I wanted to have this opportunity to tell you how much we appreciate your support of education programs at the Department of Energy. We are going to miss you, and we are going to miss the support that you have given us in the past, and look forward to working, of course, with the subcommittee in the future. But your support has been very, very welcome to us.

Mrs. LLOYD. Why I thank you very much, and I wish you well.

Mr. STEPHENS. Thank you. I would also like to submit my testimony for the record.

Mrs. LLOYD. Without objection, all of your statements will be made a part of the record and you may summarize.

Mr. STEPHENS. All right. I have shared with the committee a copy of the recently issued catalog of education programs for the Department and I just have to point out that these have a very smart young woman on the cover. It just turns out the young woman is also from Oak Ridge, Tennessee. Nothing—it was just a fortuitous, I think,—

Mrs. LLOYD. Well, I certainly expect Oak Ridge to be included.

Mr. STEPHENS. That is true.

But this catalog will give members of the committee, I think, a lot of information about all of the programs that the Department is responsible for in education, many of which do deal with women and people of color. As a matter of fact, that has been our number one priority over the last several years: trying to raise the number of women and people of color in all of our education programs.

Right now, if you look at our undergraduate programs about a third of our participants are women. In our high school programs it ranges from a low of 10 percent to a high of about 20 percent, so we need to do much more and we will continue to increase that percentage.

My testimony touches on a number of programs that the Department is involved with that specifically support young women in science all the way through the pipeline, as early as preschool all the way up to our postgraduate programs. Let me share, though, just a few anecdotal activities with you, trying to give you some sense of what the Department has really been trying to do using our collection of, frankly, unparalleled scientific resources, namely, people and/or facilities in our world-class national laboratories.

There was a recent study done at UCLA on seventh graders where it pointed out that although boys and girls performed equally well in math and science classes, girls consistently underestimated their abilities. Since science is often viewed as a masculine field, women are not encouraged to take math and science classes, and as I indicated earlier, my daughters certainly are classic examples of that. Coupled with a lack of self-confidence, this means that many women who could do well in science classes simply do not take them.

Our laboratories and our scientists in our laboratories try to place their unique and exciting resources at the service of education by working with teachers and students to motivate students and enhance the ability of teachers to teach their subjects. We spend a lot of time arranging contacts between our laboratory scientists and students, especially women and people of color. These role models volunteer, and are effective and enthusiastic doing so, at least in part because they wish someone had done it for them when they were younger.

Let me take just a moment and show you the images of how young men and women view scientists. These are middle school students, and I want to show over here on the side, if you wouldn't mind, Robin, showing that first placard.

This is a quote from a young woman in a program out at the Pacific Northwest Laboratory: "I think a scientist is a person that never played any sports, was a nerd in school and did not have any friends because he was always working on science projects. He wears a white jacket. He is half bald and wears wire glasses. His only joy in life is to discover something new or buy a used pocket protector for a quarter. He has shiny, formal black shoes, 10 pens and 4 pencils in his right front pocket. In his left pocket he has a white pair of rubber gloves".

This preconceived stereotypical image is a mindset of most of the middle grade girls throughout this country. And what we are trying to do in our various programs, and I summarize that in my written testimony—and I am going to give you a few examples—is try to help break that glass ceiling as early as we possibly can throughout the spectrum of our various activities.

Some of the programs that we are involved with include a whole range of science museum programs, many of which deal with young women. I do want to call your attention to one very spectacularly successful project. It is a small museum outside—near the Fermi Laboratory in Chicago—where the girls from a Girl Scout group, ages 10 to 14, actually construct hands-on science exhibits tough enough to stand up to the expirations of thousands of visitors.

The girls are sponsored by a variety of local organizations. In 2 months, guided by women mentors in science and construction, the young builders purchased the necessary materials and tools, design and literally assemble their exhibits in physics, math and chemistry.

In the course of construction they learn to solder and use several power tools. Each girl gains firsthand knowledge of the scientific principle behind the exhibit and revels in her accomplishments.

It is their parents who really bring it to home. They say, "Really! My daughter did this."

We have one project that I want to also call your attention to which shows the power of new technology to excite young women and men about science. One of the things the Department takes a lot of pride in is the ability to connect real science in our laboratories to the classroom, and not more than several months ago we had an interesting experience where one of our programs involves a telescope out at the Lawrence-Berkeley Laboratory, which is automated. It is part of what we call our Hands-On Universe Program where classrooms throughout the country link in and actually take images from the telescope and use them to conduct real science in the classroom.

On the morning of May 10th, the Hands-On Universe Program was cited for the supernova discovery of two female high school students, Melody Spence and Heather Tartara from Oil City Senior High School in Pennsylvania. These two students had requested images of a gorgeous cluster of stars, about 13 million light-years away from the telescope.

And these are the two students who actually conducted the experiments. They were intrigued by what a whirlpool galaxy would look like. The photographs revealed a newly discovered supernova just as it erupted. Heather now looks to the night sky with a much different approach. She says you think, What am I going to find this time?

Let me share with you two letters from that same class to their teacher.

"I am a student that have been working on the Hands-On Science Program for one year now. This program has taught me that even though I may get the best grades when it comes to book work, when it comes to working on something I can do myself I can accomplish much more. I was a learning disabled student until last year and science was always my weakest subject. When my counselor told me I was going to have to transfer to regular science class I was scared that I may not do well and would have to go back to the LD classes. In the beginning of the year I was not doing too well. Since that time I was introduced to the Hands-On Universe Program. My grades have gone from a D and an F to an A and a B. I have also learned that I can use this program for other classes beside science. This program has given me self-confidence and has also helped me make my choice to become a future teacher".

And one other letter I would like to share with you from the same program.

"I know there is a special reason why I love this program. It has taught me to take interest in my education again. Recognize these are seventh graders. I know that part does not make any sense. Let me explain. At the beginning of this year I did not have any interest in school. I almost did not care about my future and I saw no reason to. My grades showed my attitude. I was constantly blowing off school on anything. One day I started listening to my teacher about this new program called Hands-On Universe. The minute she said computers, I started listening. I love to work on computers. Anyway, after working on the program I found that I was hooked on science. One major side effect was that my interest in all schooling was renewed. I actually enjoy coming now and learning new things, not just in this class but all others as well. My math grades have improved. For me math has always been a struggle and I was never very good. But thanks to this particular program I have now learned to look at things a little differently and to just keep trying. When I was younger I loved science. I just could not get enough of it. I remember how much fun science is. This has now made me plan to study for a career in oceanography and marine biology. This program has made such a difference in my life. If it was not here for me to lean on I really do not know where I would be today". And again, this is a seventh grade—sixth grade, seventh grade young woman.

So, these are just examples. If you reach students at that earlier age with the kinds of experiences that do real science, their confidence grows and they will know where they want to be down the road.

Mrs. LLOYD. They are beautiful, beautiful success stories. Wonderful success stories.

Mr. STEPHENS. Let me just close by sharing with you, after we bring in scientists into the classroom and work with students and their teachers and spend the periods of great intense concentration that our scientists do in a classroom, student images of science also begin to change. And, if I can show you that last placard there which talks about after the fact, after young women and young men have worked with scientists, this now is the same young woman who said "a scientist looks like any person except that a scientist studies the earth and space and tries to help the environment. Even if a scientist is a woman she is just as good as a man. Scientists are trying to make a better future for us all".

So, Madam Chair, these are just some of the programs the Department is involved with. We have many others. They are certainly summarized in our Education Programs Catalog.

We are proud of what we do. We are going to do more. And we do appreciate the support this committee—

Mrs. LLOYD. Well, I hope you get the opportunity to tell this story many times. Thank you very much.

Mr. STEPHENS. Thank you.

[The prepared statement of Mr. Stephens follows:]

STATEMENT OF
RICHARD E. STEPHENS
DIRECTOR FOR OFFICE OF UNIVERSITY AND
SCIENCE EDUCATION
DEPARTMENT OF ENERGY
BEFORE THE
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
SUBCOMMITTEE ON ENERGY
HOUSE OF REPRESENTATIVES
June 28, 1994

Honorable Representative Lloyd and other distinguished members of the House.

I am honored today to represent the Department of Energy's Office of Science Education and Technical Information and share with you some of the regional and national education programs conducted by the Department of Energy's headquarters, laboratories and facilities that focus on females and other underrepresented minorities. I have brought a number of our 1994 Education Program Catalogs for you to see the range of our programs, as well as the 1994 Guidebook to Excellence which has the input of 16 federal agencies and what they are supporting in K-12 science education.

The Department of Energy's strategic plan includes a strong commitment for supporting science education as one of the key elements in ensuring future scientific and technical leadership for continued economic competitiveness. The strategic plan also calls for the Department to help provide a technically trained and diverse workforce for both the Department and the Nation by enhancing scientific and technical literacy of both youth and adults on energy and environmental issues.

The Office of Science Education and Technical Information is responsible for overall coordination and policy direction of the Department's involvement in science education at all levels of education -- precollege through postgraduate and across all Departmental missions and programs. The Office has developed a new strategic plan for the support of science education which includes a Learning Continuum and a set of Action Strategies

**Learning Continuum**

The Office of Science Education and Technical Information has two basic goals in supporting mathematics and science education as illustrated by the Learning Continuum (Exhibit I).

-- Our first goal is to ensure that the Department's own staffing needs are met and are fully representative of our Nation's diverse population. Until the late-1980's, the primary focus of the DOE education programs was on encouraging university students to pursue careers in the DOE-related scientific and technical areas through student scholarships and research appointments at DOE facilities. Research appointments were in fields that included mathematics, physics, geology, chemistry, zoology, biology, and other areas of basic and applied research.

-- Our second goal is to do our part to achieve a high level of a scientifically and technically literate citizenry. We have exciting strategies like the Science Museum programs which provide hands on, direct experiences with scientific phenomenon designed to stimulate interest in and awareness of scientific and technical concepts. Since 1989, the Department's science education mission has been significantly expanded to include programs directed at early intervention at the Pre-K through 12 levels as well as programs developed to increase science literacy. The Department's strategy in precollege science education support is based on five premises:

- Serious efforts to produce students with excellent mathematics and science skills must begin at the elementary school level and reach all students;

- Science and mathematics teachers must become full partners in the scientific community;

- Programs must encourage full participation individuals traditionally underrepresented in mathematics, science, engineering, and technology;

- DOE must use more fully utilize its unique regional scientific facilities and staff to help improve mathematics and science education;

- DOE's efforts must be totally integrated with those of other Federal agencies, the States, and private sector to yield the greatest benefit for the Nation.

-- We will also position ourselves to support the Administration's major commitment to technical training, ensuring a smoother transition from school-to-work, and providing for the retraining of workers displaced as a result of the end of the Cold War. Beginning in 1995 DOE's education programs will be expanded with a new focus on community colleges and vocational schools, where critical technical skills are taught.

We will help to ensure that all students possess a passion for continuous learning, whether on the job or in higher education and are equipped to more easily adapt to rapidly changing job requirements and future employment needs, and to assure the pipeline for future scientists and engineers.

**Action Strategies**

In a perfect world of unlimited resources, we would fund every good idea. But, in the real world of diminishing resources, we are forced to make hard choices based on a rationale that delivers results. We use action strategies, to apply this new thinking to our current programs, as well as to make decisions on new proposals. Some of those strategies include:

-- The "Hands On Universe" program at the Lawrence Berkeley Laboratory (LBL) illustrates the use of State-of-the-Art Technology to meet young people at their point of interest. Students from all over the country can access a multi-million dollar mainframe and do actual math, physics and astronomy computations.

- On the morning of May 10 on NBC's "Nightside," the Hands-On Universe program was cited for the supernova discovery of the two female high school students, **Melody Spence and Heather Tartara** from Oil City Senior High, PA. These two students had requested images of a gorgeous cluster of stars about 13 million light years away from the LBL telescope because they were intrigued by what a "whirlpool" galaxy would look like. The photographs revealed a newly discovered supernova, or exploding star, just as it erupted. Heather now looks to the night sky with a different approach. She says, "you think 'What am I going to find this time?'"

-- Another action strategy focuses on the family as a learning unit. Several of our laboratories use the Family Math Program, developed at the Lawrence Hall of Science, and used in educational outreach programs at several labs, provides much needed opportunities for involving families in their children's learning process. This recognizes the need for educational support at home.

-- Another strategy notes that reform in science education must be institutionalized and continued, hence, our focus on Systemic Reform. This involves a fundamental change of institutions and their systems, that is, the ways educators and policy makers define and deliver the curriculum, instruction, assessment, professional development, management, finance and governance of education.

-- A fourth action strategy emphasizes Evaluation and Assessment. We have pursued a rigorous program for quality of science content and instruction by doing the following:

- providing priority funding to systemic teacher and student programs since they hold the most promise for accomplishing learner achievement in science, mathematics and technology;
- providing evaluation training for all DOE education program managers
- collaborating with the National Center for Improving Science Education (NCISE) in the development of templates from research and best practice for program design, implementation and evaluation, and in the development of appropriate evaluation tools to measure impact.
- participating in an interagency National Science and Technology Council

(NSTC) evaluation of teacher programs to determine the best practice across all agencies (the evaluation tools developed by the Department and NCISE will be used for the cross-agency evaluation); and

- developing a decision-making tool for the review of program plans and grants submitted to the Department.

All of our goals, objectives and strategies must hinge upon the concept that the accomplishments we strive for should be independent of individuals and personalities. We expect our achievements to be long lasting and to span the learning continuum, and ultimately eliminate the need for "one shot" and "band-aid" programs.

The Department oversees an unparalleled collection of scientific and technical facilities and equipment with extraordinary potential for kindling in students and the general public a sense of excitement about science and for increasing science literacy. Programs funded by DOE and its contractors annually reach more than 1 million students, educators, and members of the public.

### Department of Energy Programs for Women

The Department's education programs place a special focus on encouraging underrepresented populations, including young women, to enter the mathematics, science, engineering and technology fields. The holes in the scientific education pipeline for women begin early on. Studies have shown that mathematics and science teachers pay more attention to boys than girls and give them more eye contact. Boys are more likely to be asked more challenging

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questions than girls in science and math classes. And in group activities, boys tend to get more involved in the "hands on" aspect by actually operating the equipment, while girls tend to record data and write reports. By middle school, many girls lose confidence in their scientific skills. According to a UCLA study of seventh graders, although boys and girls performed equally well in math and science classes, girls consistently underestimated their abilities. Since science is often viewed as a masculine field, women aren't encouraged to take math and science classes. Coupled with their lack of self-confidence, this means that many women who could do well in science classes simply don't take them.

The DOE laboratories and facilities around the country are trying to place their unique and exciting resources at the service of education, emphasizing working with the school systems and the education community to pioneer innovative and effective programs in science and math education. A major goal is to provide opportunities and experiences to motivate students and enhance teachers. They arrange lots of contact between students and laboratory-staff role models -- especially women and other underrepresented groups. The role models volunteer and are effective and enthusiastic doing so, at least in part because they wish someone had done it for them when they were younger.

Let's take a moment and conjure the images of some middle grade students in the OPTIONS program at our Pacific Northwest Laboratory in Richland, Washington.

"I think a scientist is a person that never played any sports, was a nerd in school and didn't have any friends because he was always working on science projects. He wears a white jacket is half bald and wears wire glasses. His only joy in life is to discover something new or buy a used pocket protector for a quarter. He has shiny formal black shoes, 10 pens and 4 pencils in his right front pocket, in his left pocket he has a white pair of rubber gloves.

This preconceived stereotyped image is a mind-set of most of the middle grade girls throughout the country. DOE is doing its part in breaking the glass ceiling in programs and events I am about to describe.

Our **Museum Science Education Program** has helped increase the public's understanding of science through energy-related exhibitions, programs, and media in science/technology centers, zoos, aquariums, and other museums since 1991. Some recent recipients include the Lexington Children's Museum, New York Zoological Society/Bronx Zoo, South Dakota Discovery Center and Aquarium, SciTech in Aurora, Illinois, the Exploratorium in San Francisco, and the Discovery Center of Idaho. A number of these programs focus on female students:

- **Energy Works in Fort Worth:** This summer, at the Fort Worth Museum of Science, 42 seventh grade minority girls, recruited from economically depressed communities, will dig for fossils, analyze owl pellets, model clay bones, map coal bearing earth layers, use computers to download satellite imagery of geologic features, and mess around with magnets, conductors, circuits, and electrical appliances. The ten-week Girls Summer Lab blends energy science, geology, and paleontology, forming a multi-disciplinary approach to the scientific method and the development of problem-solving skills.

At Texas Christian University, 12-14 year old girls will talk with female graduate students and geology professors about personal interests and science careers. At the "Big Brown" power plant, the Texas Utilities' Fairfield facility, the girls will collect coal samples, tour the control room, and observe the huge burners that produce steam under pressure for electricity.

With a paleontologist, the students will explore a dinosaur dig currently being excavated near Fort Worth where massive bone conglomerates of Pleurocoelus and the sauropod family litter the ground. They will go one-on-one with an inspiring paleobotanist about life as a field scientist and why she chose her career path.

These are at-risk kids, girls left out when opportunity knocked. Soon they will become "explainers" at the Fort Worth Museum of Science and History. They will turn-on to science and each other -- discovering, nurturing, and growing together.

- **SciTech Clubs for Girls** is another successful museum program. In Aurora, outside Chicago, girls ages 10-14 construct hands-on science exhibits tough enough to stand up to the explorations of thousands of visitors to SciTech (Science and Technology Interactive Center). The girls are sponsored by

Scout Councils, Urban Leagues, Catholic Youth Organizations, the African American Pastors. In two months, guided by women mentors in science and construction, the young builders purchase the necessary materials and tools, design and literally assemble their exhibits in physics, mathematics, and chemistry. In the course of construction, the girls learn to solder and use several power tools. Each girl gains first-hand knowledge of the scientific principle behind the exhibit and revels in her accomplishments. But it's their parents who exclaim, "Really, my daughter did this?"

**New Explorers Partners.**

The PBS series, "The New Explorers" with Bill Kurtis just recently won the George Peabody Award in broadcasting achievement which is equivalent to the Pulitzer for the series and the educational materials. Women in Science that have been showcased on the "New Explorers" are **Phyllis Pitluga**, an astronomer at the Adler Planetarium and German scientist **Maria Reiche** who are studying the giant figures, shapes, and lines etched in the Peruvian desert that have puzzled humans for more than 2,000 years; **Dr. Betsy Dresser** of the Cincinnati Zoo explains the latest methods in human reproductive technology in helping to save endangered animal species; and **Dr. Mae Jemison**, the first African-American women to journey into space discusses her educational studies beginning in the Chicago inner-city schools and then re-counts her space travels before, during and after lift-off.

Nationwide DOE is involved with over 30 museums and community organizations which serve as 'New Explorers' partner sites to (1) disseminate excellent science that is required in the classroom; (2) present scientific career information with a concentration on minorities and women; (3) provide hands-on experiences with scientific methodologies; (4) provide contact with scientists and real scientific materials; and (5) show how students could become scientists.

To date, in the Chicago area alone, over 100,000 students have with their teachers, used the New Explorers video tapes, two weeks of curriculum related activities associated with that video, had an awareness of career potential, and taken a field trip to the partner site. This program is our premier initiative in increasing the public understanding of science.

Similar partnerships in Boston include local schools and the Museum of Science, the New England Science Center, and the New England Aquarium. In Washington, D.C., schools are working with the Smithsonian Institution through the Anacostia Museum and the National Zoological Park's New Opportunities in Animal Health Sciences (NOAHS) Center. Other cities, schools, and laboratories with similar programs include Central School in Somerville, New Jersey, and Princeton Plasma Physics Laboratory; Fernald Environmental Management Project and Cincinnati schools, zoo and museums; SciTrek and Zoo Atlanta in Atlanta; and the Science Museum of Minnesota.

**Magic School Bus**

"If you keep asking questions, you'll keep getting answers," says Ms. Frizzle, the zany teacher in the new fully animated series, The Magic School Bus. PBS will premier the new series, in September. Ms. Frizzle brings her spirited personality as she urges her multi-ethnic class of kids to "Take chances!"

Ms. Frizzle is a terrific role model for girls because of her enthusiasm and determination. The Department of Energy, along with The National Science Foundation, Microsoft Home and the Carnegie Corporation of New York is providing financial support for this series.

**Hands-On Universe.**

I have previously mentioned the Hands-On Universe program which makes cutting-edge astrophysics research tools and technologies available to a wide precollege audience. Through microcomputers and electronic networks, participants can request astronomical images from the LBL professional-grade telescopes. The microcomputers and communication networks also link participants and professionals in genuinely collaborative apprenticeships.

In addition, work is under way to develop astronomy-based science curriculum units for use in the high school classroom, user-friendly image-processing software, astrophysics museum exhibits, and planetarium programs. The National Science Foundation has also provided funding for this program.

For one female student, **Tammy Lynch**, Hands-On Universe has changed her life. "...This program has taught me that even though I may not get the best grades when it comes to book work, when it comes to working on something I can do myself, I can accomplish much more. I was a Learning Disabled student and science was always my weak subject. When my counselor told me I was going to be transferred to a regular science class, I was scared that I may not do too well, and I would have to go back to LD classes....My teacher introduced me to the Hands-On Universe program. Ever since that time my grades have gone from

D and F to A and B...."

**PreFreshman Enrichment Program (PREP)** is one national precollege program that is not held at the Department's national laboratories and facilities. Participating institutions, primarily colleges and universities with science-based degree programs, conduct summer institutes for 6th to 10th grade students from groups typically underrepresented in mathematics and science.

The goal of these 4- to 8-week programs is to capture and retain student interest in science by guiding them to choose college-preparatory science and mathematics courses. The summer activities focus on encouraging students, particularly young women and minorities, to consider careers in science-related fields. PREP provides a number of enrichment experiences, including laboratory work, field trips, tutoring, and counseling.

Three of the PREP programs have focused specifically on females:

**Seattle MESA Science Program for Girls.** During the summer, 36 middle school girls from 10 schools in the greater Seattle area met four hours a day to acquire first hand knowledge of computers and how they are used in science and technology. Seventh and eight graders from five ethnic backgrounds, African American, Asian, Caucasian, Hispanic, and native American, participated in hands-on science labs that incorporated the computer as a basic tool to collect and analyze data. Each week ended with a field trip to observe the use of computers in the science workplace.

**Pacific University Science and Technology Camp for Girls.** During the 4 week camp a week is spent studying each of the following: biology, chemistry, physics, and mathematics/computer science. In all academic areas there is virtually no lecturing by faculty, instead, emphasizing student understanding and discovery through lab work. During a typical week two afternoons are spend on field trips to local scientific companies or research. The other days had labs all morning and afternoon with a long break mid-day for lunch and physical activity.

**Sierra Nevada College.** Project curriculum focuses on the environmental science components of watersheds, water quality, hydrology, physics, geography, geology, ecology, and wildlife, including the mathematics components of algebra, statistics, formulas, conversions, ratio, proportion, calculus, geometry rates of changes, volume, area, percentages, scales, plotting densities, graphing, and demographics. Instruction is characterized as hands-on, field-based, motivational experiences where female role models engage participants interactively in participatory processes to complete a research study resulting in reports and presentations to faculty, parents, the community and at the participants' individual school sites.

**"Spectacles," Weslyan Summer Camp**

Through fun, hands-on experiments using chemical analysis, girls extract and distill, employing organic chemistry to learn the synthesis of perfume from natural sources, over 60 middle grade girls from Georgia, Florida, South and North Carolina, California, Tennessee, Alabama, and Virginia engage in innovative mathematics and science curriculum. This summer two separate two week summer camps called "Spectacles" will be conducted on the campus of the all women school, Wesleyan College in Macon, Georgia. These camps will allow girls to interact with outstanding female educators and scientists who also conduct an "Expanding Your Horizons" in science and mathematics career presentations. Now in its fourth summer, Wesleyan is tracking all of the participants throughout their continuing education. Already, Wesleyan has assessed through self-report measures, participant attitudes toward the study of math and science after participation in the project. Following are the objectives of the 'Spectacles' program:

- To intervene to change middle school girls' counterproductive beliefs about science and mathematics;

- To engage middle school girls in the study of math and science in order that they will be inspired to enroll in additional math and science courses in middle and high school, thus leaving open the opportunity for further study in these areas.

I would like to share with you some anecdotes of those who have attended the 'Spectacles' camp and what the experience has meant to the girls, their families and their communities:

- A mother of a 7th grade girl in Pacolet, South Carolina had a bake sale; she baked all the cakes, and sold them in front of a local store to raise money so that her daughter could attend a special summer camp. She also planned a yard sale and was willing to hitchhike to Macon, Georgia to get her daughter to participate in the math and science summer experience.

- Macon 2000, a local group whose mission is public education improvement in Bibb County, Georgia, has provided two scholarships for two girls from the most depressed middle school in the county to attend a special camp.

- One camp goer sold onions to four different concerns in order to raise money for tuition to learn math and science.

- A teacher contributed part of the tuition from one of her students to attend the camp and then drove her from her home in South Carolina.

- A rising 6th grade girl from Bibb County, GA who has advanced cerebral palsy is attending the camp, the first residential program that she has been able to participate in.

- A single parent who works as a telephone operator gave her financial status and how her paycheck was used each month. She asked that she be allowed to pay $20 every two weeks until she paid for her daughter to go to this special camp.

**Expanding Your Horizons Conferences.**

Several of the DOE laboratories have helped to co-sponsor Expanding Your Horizons workshops. These one day workshops are designed to provide 6-12 grade young women with women role models in scientific and technical careers. Over 1800 young women attended the four regional conferences held in the Central Valley and Bay Area in California, co-sponsored by the Lawrence Livermore and Sandia National Laboratories.

The purpose is to provide a fun program with enthusiastic role models and hands-on activities to encourage young women in science, mathematics and engineering careers.

**DOE Review of Laboratory Programs for Women**

In 1990, the need was suggested for a review of education programs at Department of Energy (DOE) laboratories that serve women and to examine the existing environment for women currently on staff. To meet this need, the DOE Review of Laboratory Programs for Women was established.

The objectives of the program review are to:

- review the status of existing laboratory programs which focus on increasing participation of young women in science, mathematics, and engineering-related careers and determine if there is a need for additional efforts to increase female participation in DOE science education programs carried out at and/or by the laboratories;

- look at the laboratory environment in which the DOE student programs are carried out, focusing on laboratory programs that enhance the status of women in science, mathematics and engineering-related careers at the DOE laboratories; and

- develop an action plan, if there is a need, for identification and implementation of additional efforts that should be undertaken by DOE Headquarters and/or the laboratories.

The Fourth Annual Review (1994) is being held in New Mexico, co-hosted by Sandia National Laboratories and Los Alamos National Laboratory; the theme of the Review is 'Weaving the Thread of Diversity into the Fabric of Quality.'

Some of the outcomes and benefits to date include:

- have identified and highlighted programs to encourage women (females K-16) to consider career options in scientific and technical careers
- are developing a strategic plan that will link with other DOE Headquarters strategic plans, i.e. Office of Science Education and Technical Information, the Diversity Council, and the Office of Economic Impact and Diversity;
- are linking with other DOE and National women's programs

The DOE laboratory and facility education offices publications and media programs have been produced to inspire young women to continue to be turned-on to science and consider careers in science.

Associated Western University's Northwest Division in Richland, Washington branch developed a booklet called **"Northwest Women in Science"** which serves as role model guidebook and resource directory to be used by students, teachers, and parents which highlights scientific careers pursued by women.

**"Breaking Through"**, a video tape produced by Sandia National Laboratory, California working with the Jet Propulsion Laboratory has won numerous awards, such as an honorable mention by the American Women in Radio and Television and Pacific Mountain Network National Commendation Award. It allows the viewers to see three women scientists who are making significant contributions to the scientific community. This video provides a strong motivating force encouraging young girls to continue their studies of math and science throughout high school and college.

This year many of the laboratories and facilities celebrated the **"Bring Your Daughter to Work Day."** One event connected with the April 28 agenda was conducted by the women at the Sandia National Laboratories Education Outreach Department. Daughters taking part in the day participated in the "Science is Fun" demonstration held during the morning with over 700 daughters taking part.

An ongoing program for the Department is our involvement with teachers in the **Teacher Research Associates Program (TRAC)**. One of the teachers was from Freehold Township in New Jersey, Susanne Flannelly. She was assigned to the Lawrence Berkeley Laboratory last summer. She cites the following as her major accomplishments: "I had the opportunity to meet Dr. Glenn Seaborg, who

discovered plutonium and a former director of the Department under four presidents. He was probably the most impressionable individual that I ever met. At 85, he still goes to work every day, although he called it 'play'. I listened to lectures on the human genome, laser technology, and the latest issues from George Smoot's new addition to the "Big Bang' theory. I actually performed an experiment on DNA fingerprinting and put together a 100 foot whale, in addition to being involved with the latest multimedia technology. I had a hard time adjusting to the fact they did not work on the (school) "bell" system. I had no idea when 45 to 60 minutes had passed.
The experience, was the most stimulating educational endeavor I have ever encountered."

In closing, I would like to reflect back to the image of the scientist that the Pacific Northwest Laboratory's OPTIONS student initially had and listen to the difference after she has had the opportunity to visit and talk with the scientists and technicians at the DOE laboratory.

"A scientist looks like any person except that a scientist studies the earth and space and tries to help the environment. Even if a scientist is a women she's just as good as a man! Scientists are trying to make a better future for us all."

Thank you for the opportunity to testify on the Department of Energy's role in providing a quality educational experience for young women across the country.

Mrs. **Lloyd**. Dr. Stutsman?

Ms. **Stutsman**. Madam Chairman and members of the subcommittee. I appreciate the opportunity to testify today on behalf of the National Science Foundation.

Science and mathematics education for women and girls is a topic of very great concern at NSF, particularly within the Education and Human Resources Directorate which I represent.

The under-representation of women in scientific and technological careers is well documented. Women do have a significant but unequal proportion of jobs in the biological and agricultural sciences, demonstrating that there are no intellectual barriers to careers in science.

To account for the very low proportion of women in the physical sciences and engineering, we must look at the barriers to careers in these fields that result from social values, attitudes of parents, teachers and peers, stereotypes, the lack of role models, inequitable teaching and learning at every level of education, sex discrimination and sexual harassment among others.

In the past few years we have begun to look at the under-representation of women in science and engineering from a larger perspective. A perspective that examines the need for institutions, systems, policies and practices to become more inclusive.

Efforts to increase the participation of women in science and engineering no longer focus on women as somehow deficient, in need of alteration so that they can fit the existing environments of science and engineering, and I think that that has been brought out earlier this afternoon much more dramatically.

The NSF is assimilating this new view through an expansion of its programs which target women and girls. Programs which target young women in K through 12 science and mathematics education are supported largely by the Education and Human Resources Directorate of NSF, although there are some efforts throughout the research divisions as well.

Our program announcement for Activities for Women and Girls encourages proposals that focus on females from kindergarten through graduate education, their parents, their teachers, and the various communities in which they learn.

We have three program areas that address these needs. The first is model programs—projects for women and girls which encourages the design, implementation, evaluation and dissemination of innovative, short-term, highly focused activities to improve access and/or retention of females in science, engineering and mathematics education and careers.

The second area, Experimental Projects for Women and Girls, supports activities that create positive and permanent changes in the academic, social and scientific climates. These changes will allow the interest and aptitude that women and girls display in science, engineering and mathematics to flourish.

Information Dissemination Activities was developed to accelerate efforts to increase girls and women's participation in science, engineering and mathematics by encouraging widespread dissemination of information and strategies about the interest, retention and advancement of women and girls in scientific and technical careers.

The Model Projects Program currently funds 13 projects that focus on young women in kindergarten through high school, their parents and teachers and others who influence their career decisions. One project, in San Antonio, Texas, called Find Your Wings, has reached more than 500 fourth through sixth grade girls. The program will be instituted nationally next year as part of the Girl Scouts of America Program Guide, and a manual and videotape will be available to groups who wish to replicate the program.

This is the first year of the experimental programs, the larger efforts. Eleven projects to be implemented over the next 3 years have been recommended for funding and will be announced shortly. Each includes some activities intended to improve the educational climate for young women in kindergarten through high school.

One represents a statewide collaboration designed to make permanent changes in women's and girls' access to and participation in science, engineering and math. The projects are targeted particularly to girls who come from economically disadvantaged and under-represented minority populations and will include a statewide clearinghouse for resources, research, symposia and conferences, and dissemination of project products.

Yet another utilizes the collaboration between a science museum, which we have talked about a bit so far, and the Girl Scouts of America, frequently mentioned already, designed to empower Girl Scout volunteers to plan, organize and direct engineering—science, engineering and mathematics activities at the grassroots level. Through a national dissemination plan, this effort can potentially reach more than 2-1/2 million Girl Scouts.

In the future NSF plans to coordinate evaluation efforts so that cross project data can be developed that would identify the types of interventions with the highest probability for success. Such an effort could also investigate whether particular interventions are more appropriate at certain ages or with certain racial/ethnic groups.

With increased attention to activities designed to encourage the participation of women and girls in science, engineering and mathematics, there is hope for real and sustained progress to be made, and the existing situation which inhibits the full participation of women should improve.

Artificial barriers to young women's progress in science, engineering and mathematics must be disassembled. Educators, employers and scientists, engineers and mathematicians themselves must recognize behaviors that have a differential impact on females and males. NSF is actively seeking ways to eliminate these barriers.

Thank you, Madam Chairman, for this opportunity to testify. And like everyone else, I will be pleased to answer questions at an appropriate time.

[The prepared statement of Ms. Stutsman follows:]

Testimony of
Jane T. Stutsman
Deputy Assistant Director
Division of Education and Human Resources
National Science Foundation

Before the
Subcommittee on Energy
House Science, Space, and Technology Committee
U.S. House of Representatives
June 28, 1994

Madam Chairman and members of the Subcommittee, I appreciate the opportunity to testify before the Subcommittee on Energy on behalf of the National Science Foundation. Women and K-12 science and mathematics education is a topic of very great interest at NSF, and particularly within the Education and Human Resources Directorate.

At the close of the twentieth century in the United States of America, the under representation of women in scientific and technological careers is a well documented and disturbing fact. Women do have a significant, but still unequal, proportion of jobs in the biological and agricultural sciences. demonstrating that there are no intallecutal barriers to women seeking careers in science. To account for the very low proportion of women in the physical sciences and engineering, we must look at the bariers to careers in these fields that result from social values, attitudes of parents, teachers, and peers, stereotypes, a lack of role models, inequitable teaching and learning at every level of education, sex discrimination, and sexual harassment among others. Today's hearing focuses attention on one segment of the continuum representing young women's progress from birth to an established career—the mathematics and science education of a young woman from kindergarten through high school.

In the past few years, a different way of looking at the under representation of women in science and engineering had begun to emerge at many different levels of education and employment. This new view supports an understanding that institutions, systems, policies, and practices need to become more inclusive. No longer do efforts to increase the participation of women only focus on them as somehow deficient, in need of alteration, so that they can "fit" the existing environments of science and engineering. The National Science Foundation is assimilating this new view through an expansion of its programs targeting women and girls. In particular a new program area, Experimental Projects for Women and Girls, funds projects which create positive and permanent changes in the academic, social, and scientific climates.

NSF's targeted programs for women and girls can be classified into three categories: Comprehensive Focus, Graduate Student Focus, and Faculty Research and Development Focus. Programs which target young women in K-12 science and mathematics education reside in the Education and Human Resources Directorate of the NSF. The greatest increase in project funding occurred in the Division of Human Resource Development with the development of several new programs intended to increase the participation of women and girls in scientific and technical careers. In addition to these targeted programs described in the following testimony, a number of projects that specifically affect young women of elementary and secondary school age are funded by other divisions in the Education and Human Resources Directorate.

The program announcement for EHR's Activities for Women and Girls (NSF 93-126) encourages proposals focusing on females from kindergarten through graduate education; their teachers or parents; and/or the various communities in which they learn.

The Model Projects for Women and Girls program encourages the design, implementation, evaluation, and dissemination of innovative, short-term, highly focused activities which improve access and/or retention of females in science, engineering and mathematics (SEM) education and careers. In addition, it supports projects which demonstrate the effectiveness of such activities through refinement and expansion, or replication with a different population or setting.

The Experimental Projects for Women and Girls program supports activities which create positive and permanent changes in the academic, social, and scientific climates that allow the interest and aptitude women and girls display in science, engineering, and mathematics to flourish. In addition, this program supports projects that add to the knowledge base regarding interactions between gender and the infrastructure of science, engineering, and mathematics, thus providing direction for future efforts.

The Information Dissemination Activities program was developed to accelerate efforts to increase girls' and women's participation in science, engineering, and mathematics by encouraging widespread dissemination of information and strategies. The intent of this program is to support activities which inform others of successful strategies that improve the participation of, or reduce barriers to, girls and women in science, engineering, and mathematics. In addition, the program provides for projects which disseminate information about the interest, retention, and advancement of women and girls in scientific and technical areas.

Three of the 11 Model Projects for Women funded through the Career Access program in 1992 were directed at the education of young women in kindergarten through high school. The projects focused on a variety of activities involving students, their teachers, and their parents. One introduced elementary school girls to physics concepts through games, toys, and experiments. A portion of a fourth project focused indirectly on the K-12 age group by training faculty and administrators from engineering schools to run pre-college activities for young women. A summary sheet referencing all of the 1992 Model Projects is attached.

In 1993, the Model Projects for Women and Girls program level increased to 16 projects, 10 of them focusing on young women in kindergarten through high school, their parents, teachers, and others who influence their career decisions. Recipients of the awards were at institutions from coast to coast and border to border. One project in San Antonio, Texas called "Find Your Wings" reached more than 500 fourth through sixth grade girls. The program will be instituted nationally in the 1994-95 school year as part of the Girl Scouts of America Program Guide. A manual and video tape are available to groups who wish to replicate the program. Another project in Seattle, Washington called NSF Young Leaders enabled small teams of young women in the eighth grade to take part in designing and directing a science project which they carried out over a six months period. Some of the young women in this program were from the American Indian Heritage School. One of them, 13 year old Raven Alexander, thought the project would be boring when it began. However, the field trips were so much fun that now she wants to become a science teacher. A summary sheet referencing all of the 1993 Model Projects is attached.

This year is the first full year in which Programs for Women and Girls exists in an expanded form, separate from programs for other under represented groups. This is the first year in which Experimental Projects for Women and Girls will be awarded. Eleven projects, to be implemented over the next three years, have been recommend for funding. Each project includes some activities intended to improve the educational climate for young women in Kindergarten through high school. One represents a state-wide collaboration designed to make permanent changes in women's and girls' access to, and participation in science, engineering, and mathematics (SEM), especially among economically disadvantaged and under represented minority populations. The project will include a state-wide clearinghouse for resources, research, symposia and conferences, and dissemination of project products; a public awareness component including local "equity partnerships"; a "self-esteem building" component to support girls and women in elementary, secondary, and college levels; and a pre-service and in-service component developing new curricula which address women in SEM issues for future and practicing teachers. Another project utilizes a collaboration between a science museum and the Girl Scouts of America designed to empower Girl Scout volunteers to plan, organize, and direct science, engineering, and mathematics activities at the grass roots level. Through a national dissemination plan more than 2,500,000 Girl Scouts in 332 councils can be touched. In addition another set of Model Projects for Women and Girls has been reviewed and 18 awards will be made.

Each of the past and current projects has included a significant evaluation component. In the future NSF hopes to coordinate evaluation efforts so that cross-project data can be developed which would suggest what type of interventions have the highest probability for success. Such an effort could also investigate whether particular interventions are more appropriate at certain ages or with certain racial or ethnic groups.

With increased attention to activities designed to encourage the participation of women and girls in science, engineering, and mathematics there is hope for real progress to be made and the existing situation which inhibits the full potential of females should improve. Artificial barriers to young women's progress in science, engineering, and mathematics must be disassembled. Educators, employers, and the scientists, engineers, and mathematicians themselves must recognize behaviors which have a differential impact on females and males. The United States of America can hope to be competitive in the global economy only when the full potential of citizens of both sexes can be realized.

## National Science Foundation - Human Resource Development Division
## 1992 Awards - Career Access Projects for Women/Girls

| Original P.I. | Institution | State | Disc. | Participants | Level | Description |
|---|---|---|---|---|---|---|
| Batra, Prem P. | Wright State Univ. | OH | Sci. | Students<br>& Teachers | H.S. | orientation course, enhance science & math courses, field trips, demonstrations, hands on experiences, mentoring, summer research experience, etc. |
| Chandrasekhar, Meera | U. of Missouri | MO | Sci. | Students | K-8 | introduce young girls to Physics concepts through games, toys, experiments, etc. |
| Daniels, Jane | Purdue University | IN | Engr. | Administrators | Multi | establish a national network of individuals interested in university level Women in Engineering Programs |
| Franz, Judith | Amer. Assoc. of Physics Teachers | MD | Sci. | Institutions | UG/G | study climate for women in physics departments across the U.S. |
| Gulari, Erdogan | U. of Michigan | MI | Engr. | Students | UG/G | encourage undergraduate engineering women to pursue & complete graduate work |
| Honey, Margaret | Bank St. Col. of Educ. | NY | Engr. | Students | H.S. | girls create machines with a computer based design tool |
| Krane, Ken S. | Oregon St. Univ. | OR | Sci. | Students | UG/G | symposium on graduate study |
| O'Barr, Jean | Duke University | NC | Sci. | Students | Grad | indentify & define obstacles encountered by grad women in science - intervene with info to faculty and a mentoring program |

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|---|---|---|---|---|---|---|
| Pagni, David L. | Cal. State, Fullerton | CA | Math. | Students | UG | provides students with scholastic and emotional support to successfully complete the calculus sequence |
| Valyo, Judy | N. J. Inst. of Tech. | NJ | Multi | Students | UG | provides community college women with mentoring and career days. Videotapes of conference will be broadcast nationally |
| Wetterhahn, Karen E. | Dartmouth College | NH | Multi | Students | UG | internships, hands-on labs, seminar, mentoring, and field trips for freshman women |

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## National Science Foundation - Human Resource Development Division
## 1993 Awards - Model Projects for Women/Girls

| Original P.I. | Institution | State | Disc. | Participants | Level | Description |
|---|---|---|---|---|---|---|
| Chandrasekhar, Meera | U. of Missouri | MO | Sci. | Students | K 8 | introduce young girls to Physics concepts through games, toys, experiments, etc. |
| Fentiman, Audeen W. | Ohio State Univ. | OH | Engr. | Students | UG | workshop to help freshman women develop skills helpful for engineering |
| Gray Mary W. | Assoc. for Women in Math | OH | Math. | Students | H.S. | math workshops, talks, and problem solving competitions |
| Holland, Nancy | Texas A & M | TX | Sci | Students | K 8 | residential program for 7th grade girls to introduce them to university life and labs |
| Johnson, Janet | Cranbrook Institute of Science | MI | Sci | Students<br>Parents<br>Teachers/Leaders | K 8 | hands on activities at science museum<br>parent support activities<br>conference for organization leaders & teachers |
| Kebbekus, Barbara | N. J. Inst. of Tech. | NJ | multi | Students | K 8 | monthly workshops, 4 week summer camp & follow-up workshop includes academics field trips, career counseling, role models,etc |
| Kerr, Barbara | Arizona State Univ. | AZ | multi | Students | H.S. | develop career guidance strategies which are relationship-oriented, values based and girl friendly |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Keshmiri, Hemaseh | Milwaukee School of Engineering | WI | Engr. | Students | U.G. | activities designed to provide freshmen women with a network of older students, alums, and faculty, to connect them to the institution. |
| Manogue, Corinne | Oregon St. Univ. | OR | Sci | Students | UG/G | symposium on graduate study |
| Marshall, Jill A. | Southwest Research Institute | TX | Multi | Students | K-8/H.S. | classroom visits by scientists & engineers hands-on experiences, field trips, all focus on aviation |
| Morrow, James | Mount Holyoke | MA | Math | Students | H.S. | summer program for h.s. girls, classrooms videotaped, workshop for dissemination |
| Nekvasil, Hanna | SUNY, Stony Brook | NY | Sci/Math | Students | UG | orientation, two semester course on becoming a scientist, interactive calculus course, mentoring, social activities |
| Pavone, Mary L. | Dartmouth College | NH | Multi | Students | UG | internships, hands-on labs, seminar, mentoring, and field trips for freshman women |
| Rodriguez, Eloy | U. of Calif, Irvine | CA | Multi | Students | HS/UG | undergraduates will serve as role models and lab instructors for local high school girls |
| Sullivan, Kathleen | Seattle Univ | WA | Sci | Students<br>Teachers | K-8/UG | 8th grade girls of color will lead a project team of a middle school teacher, undergrad science major, and a practicing scientist |
| Wall, Judy D. | U. of Missouri | MO | Multi | Students | UG | Summer research experience to encourage continuation to graduate education |

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Mrs. LLOYD. Ms. Kass, we look forward to hearing from you.

Ms. KASS. Good afternoon, Madam Chairwoman, Congressional Representatives and friends. I am honored to appear before you to contribute the expertise of Girls, Incorporated to your review of the discussion of the data on achievement, participation and the treatment of girls in math and science.

Girls, Incorporated, is a national youth service program development, training, research and advocacy organization. Our programs are offered through a network of affiliates located in more than 700 professionally staffed sites across the country.

Our programs, based on research and rigorously evaluated, are widely recognized as being on the cutting edge, addressing what girls need to be healthy, productive and confident now and later.

Girls, Incorporated, created Operation Smart, which stands for science, math, and relevant technology, in 1985, in response to a workforce crisis facing our Nation. Although more and more jobs in all areas and at all levels require math and science skills, girls are still steered away from these subjects in school. We heard a lot more about that earlier.

Fifteen years ago, math was identified as a critical filter. The lack of high school math limits or prevents access to a wide range of high-paying and professional employment opportunities. The consequence is that while women and minorities now represent the majority of those entering the workforce their employment opportunities are severely limited. It is not surprising that women and children also represent the majority of those living in poverty. The cost to this country and its citizens is enormous.

Since the creation of Operation SMART, Girls Incorporated has produced model programs and materials for girls ages 6 through 18. Our curricula in conjunction with comprehensive professional and in-service training, enable Girls Incorporated centers, other community agencies, science centers and schools to offer informal, hands on science education programs. By encouraging girls to ask their own questions, create their own experiments and test their own hypotheses, Operation Smart prepares girls to enroll in higher level math and science courses in high school and college and to acquire an attitude of inquiry towards everything that they do.

The success of Operation Smart is echoed by its supporters who see using informal math and science education in addition to that offered in formal education settings as crucial to insuring the future of the Nation's workforce. Informal education settings such as Girls Incorporated centers, museums, YWCAs, settlement houses and other community-based organizations play an important role in equitable math and science education for girls.

Programs in out-of-school, voluntary settings can more easily confront attitudes and biases because they are removed from the institutions in which many of these biases are played out.

Research has uncovered these biases as they relate to girls' opportunities to pursue math and science in school. Informal education programs can serve to expand on the knowledge that girls gain in school and provide the extra resources and extra attention girls may require to compensate for the lack of equity in their early and current educational experiences.

In 1990, Girls, Incorporated released the Explorer'S Pass, our study of the messages to girls and young women 9 to 14 about science, math and technology. From this ethnographic research we learned that girls are eager to participate in math, science and technology if it focuses on getting messy, taking risks, asking questions, and no right answers.

To ensure girls and young women's participation in math, science and technology in and out of school, it is important to go beyond the legally conceived notion of equity as equal opportunity. Elizabeth Fennema of the University of Wisconsin makes useful distinctions between equity of access, equity of treatment, and equity of outcome. Along with other members of the National Coalition for Women and Girls in Education, Girls Incorporated, worked to craft the Gender Equity in Education Amendments and gained the support of the Congressional Caucus on Women's Issues in bringing these issues to the public attention.

We have worked for the incorporation of gender equity provisions in several education and employment bills that have been addressed by this Congress. We welcome the opportunity to work with the committee to implement action as a result of this legislation.

We applaud the committee for focusing on issues related to girls' participation in math and science. Your attention will do much to ensure that the intent of the gender equity provisions of the Improving America's Schools Act of 1994 is implemented.

Thank you.

[The prepared statement of Ms. Kass follows:]

**Girls Incorporated**

30 East 33rd Street
New York, NY 10016-5394
Tel: 212 689 3700
Fax: 212 683 1253

girls
inc.

Growing up is
serious business

**Statement of Girls Incorporated**
**"Women and K-12 Science and**
**Mathematics Education"**

**Testimony of**

**Stacy H. Kass**
**Director**
**Careers and Life Planning**
**Girls Incorporated**
**New York**

**Before the**
**Subcommittee on Energy**
**of the**
**Committee on Science, Space and Technology**
**of the**
**U.S House of Representatives**

**June 28, 1994**

Good afternoon Congressional representatives and friends. I am Stacy Kass, Director of Careers and Life Planning at Girls Incorporated. I am honored to appear before you to contribute the expertise of Girls Incorporated to your review and discussion of the data on the achievement, participation and treatment of girls in math and science classes at the elementary and secondary school levels.

Girls Incorporated is a national youth service, program development, training, research and advocacy organization. Our programs are offered through a network of affiliates, located in more than 700 professionally staffed sites across the country. Founded in 1945 as Girls Clubs of America, Girls Incorporated centers date back to the Industrial Revolution, where they were formed in the northeast mill towns to provide a safe haven for the daughters of the factory workers and for the young women who worked in the factories. Since then, the organization has continued to meet the changing needs of girls and young women and committed itself to helping them overcome discrimination while working to make society more equitable.

Girls Incorporated has heavily invested in program development for the past ten years. Our programs, based on research and rigorously evaluated, are widely recognized as being on the cutting edge, addressing what girls need to be healthy, productive and confident now and later. They are used by schools, community organizations, professional associations, science museums and health clinics as well as by our own affiliates, who collaborate with us on the design and testing.

The Girls Incorporated National Resource Center, founded in 1981, is the research, evaluation, training and dissemination arm of the organization. Providing the link between theoretical research and practical application, the Resource Center is a unique clearinghouse of knowledge about girls' needs and the best programs to meet them. The Resource Center makes it possible to conduct the rigorous evaluation and research that are an integral part of all our program development efforts.

Today's girls grow up in an inequitable world where gender discrimination limits their opportunities, experiences and accomplishments. From the moment that a baby is identified as a girl, she is subject to familial, societal and cultural expectations that regard the fact of her gender as more important than her interests and her capabilities. She is a girl first, a child second -- limited to those activities and pursuits deemed appropriate for her sex. These constraints serve to deny her opportunities to develop into an adult who is a person first, a woman second. Starting very early on, girls are repeatedly rewarded for being polite, behaving well and looking pretty, while boys are rewarded for making objects, completing projects and winning. A girl who learns to value and derive self-worth from superficial attributes grows into a woman who has not mastered the skills she needs to be economically independent -- enhanced by her ability to obtain a job in high paying math and science fields, self-sufficient and powerful.

Girls Incorporated created Operation SMART (Science, Math And Relevant Technology) in 1985 in response to a crisis facing our nation. America's position as a leader in technology and our competitiveness in the world economy are threatened by the poor math and science performance of our children as compared with other industrialized nations, and by the underrepresentation of women and minorities in science and technical fields. The United States is currently experiencing a serious shortage both of trained scientists and engineers and of workers with basic skills needed to perform jobs in an increasingly technological world. Although more and more jobs in all areas and at all levels require math and science skills, girls are still steered away from these subjects in school. Fifteen years ago math was identified as a "critical filter". The lack of high school math limits or prevents access to a wide range of high paying and professional employment opportunities. The consequence is that while women and minorities now represent the majority of those entering the work force, their employment opportunities are severely limited. It is not surprising that women and children also represent the majority of those living in poverty. The cost to this country and its citizens is enormous.

Since the creation of Operation SMART, Girls Incorporated has produced model programs and materials for girls ages 6 through 18. Our curricula in conjunction with comprehensive professional and in-service training enable Girls Incorporated centers, other community agencies, science centers and schools to offer informal, hands-on science education programs. Operation SMART encourages girls to explore the world around them, to take things apart, to be critical and skeptical thinkers, to observe and estimate and hypothesize and above all to question. The program combines hands-on activities and career development with a conscious focus on equity, a commitment to sharing decision-making with girls, and opportunities for girls to take action in their communities around science- and technology-related issues. Whether the activity is dissecting owl pellets, experimenting with chemical reactions or making a battery, Operation SMART helps to develop knowledge, skills and persistence. By encouraging girls to ask their own questions, create their own experiments and test their own hypotheses, Operation SMART prepares girls to enroll in higher level math and science courses in high school and college, and to acquire an attitude of inquiry toward everything they do. Eighty percent of all Girls Incorporated affiliates offer Operation SMART programs including Girls Incorporated of Chattanooga, TN, Girls Incorporated of Huntsville, AL, and Girls Incorporated of Bethlehem, PA. I am submitting for the record some press coverage of Operation SMART.

The success of Operation SMART is echoed by its supporters who see using informal math and science education in addition to that offered in formal education settings as crucial to insuring the future of the nation's work force. The National Science Foundation has funded Operation SMART since 1986, and other major foundations and corporations, including the Carnegie Corporation of New York, The Ford Foundation, and the General Electric Foundation, have provided generous grants to the project. Informal educational settings such as Girls Incorporated centers, museums, YWCAs, settlement houses and other community based organizations play an important role in equitable math and science education for girls. Programs in out-of-school, voluntary settings can more easily confront attitudes and biases, because they are removed from the institutions in which many of these biases are played out. Research has uncovered these biases as they relate to girls' opportunities to pursue math and science in school. Informal education programs can serve to expand the knowledge girls gain in schools, and provide the extra resources and attention girls may require to compensate for the lack of equity in their early and current educational experience.

In 1990, Girls Incorporated released "The Explorer's Pass", our study of messages to girls and young women ages 9 to 14 about math, science and technology. From this ethnographic research, we learned that girls are eager to participate in math, science and technology if it focuses on getting messy, taking risks, asking questions and no right answers. Our research led to the following suggestions of ways to encourage girls to explore science, math and technology.

- Provide programs and opportunities to girls that you would to boys.
- Compensate for opportunities that girls are unlikely to have. Don't wait for girls to ask for them.
- Provide girls with opportunities and resources to develop the strength and skills necessary to accomplish their objectives.
- Highlight the science, math and technology in areas more traditional for girls.
- Provide not only opportunity, but encouragement, resources and support for girls to plan and carry out challenging activities such as hikes, campouts and science fairs.

To insure girls' and young women's participation in math, science and technology in and out of school, it is important to go beyond the legally conceived notions of equity as equal opportunity. Elizabeth Fennema, of the University of Wisconsin, makes useful distinctions between equity of access, equity of treatment and equity of outcome.

- Equity of access means, at least, equal opportunity to participate in a program.

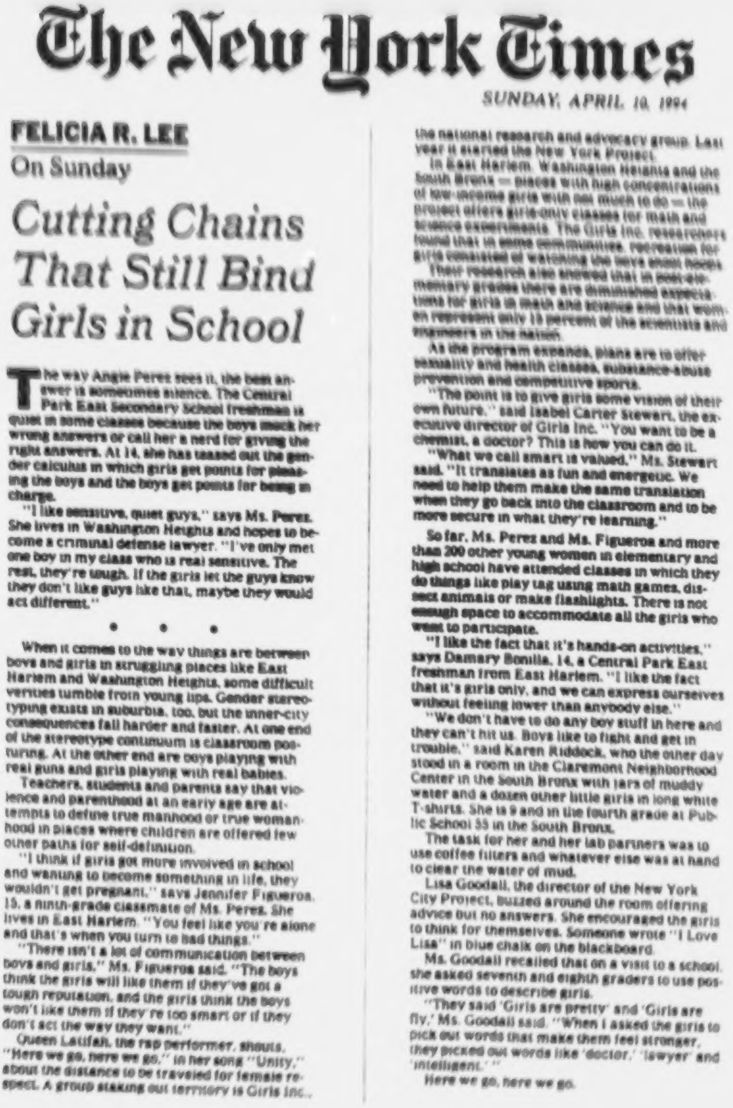
Access is far more than not excluding girls and young women deliberately.

- Equity of treatment implies that girls receive at least the same level and quality of attention and resources as do boys -- it has been well documented that this is not the case in most classrooms and in other settings. Equity of treatment for girls, as a group that has been historically excluded, may include different or additional program components to compensate for the opportunities denied.
- Equity of outcome measures whether the gap between females and males in achievement, confidence, persistence and participation has been eliminated or significantly reduced. This concept should guide any strategies to provide programs, support and training.

These principles along with our success in Operation SMART led Girls Incorporated to a productive collaboration with the Eureka Teen Achievement Program. Eureka is a summer career and leadership development program to encourage pre-college minority women, primarily from economically disadvantaged families, to pursue high achievement in mathematics, science and sports, and eventually, to consider careers in related fields. The program was established in 1987 and has been the subject of longitudinal evaluation by the Educational Testing Service, demonstrating that the program has a dramatic impact on girls' interest, performance and participation in science and math. Girls Incorporated and Eureka staff have been working together to develop a model that can be widely replicated among Girls Incorporated affiliates and other girl serving organizations. Four Girls Incorporated affiliates are demonstration sites for the Eureka program: Girls Incorporated of Central

Alabama, AL, Girls Incorporated of San Leandro, CA, Girls Incorporated of Indianapolis, IN, and Girls Incorporated of Lynn, MA.

Girls Incorporated has submitted testimony that describe our programs and offer recommendations about how to improve math and science education for girls for both the House and Senate hearings on the Improving America's Schools Act of 1994. Along with other members of the National Coalition for Women and Girls in Education, Girls Incorporated worked to craft the Gender Equity in Education Amendments and gain the support of the Congressional Caucus on Women's Issues in bringing these issues to public attention. We have worked for the incorporation of gender equity provisions in several education and employment bills that have been addressed by this Congress. We welcome the opportunity to work with this Committee to implement action as a result of this legislation. We applaud the Committee for focusing on the issues related to improving girls' participation in math and science. Your attention will do much to ensure that the intent of gender equity provisions of the Improving America's Schools Act of 1994 is implemented.



The New York Times

SUNDAY, APRIL 10, 1994

**FELICIA R. LEE**

On Sunday

# Cutting Chains That Still Bind Girls in School

The way Angie Perez sees it, the best answer is sometimes silence. The Central Park East Secondary School freshman is quiet in some classes because the boys mock her wrong answers or call her a nerd for giving the right answers. At 14, she has teased out the gender calculus in which girls get points for pleasing the boys and the boys get points for being in charge.

"I like sensitive, quiet guys," says Ms. Perez. She lives in Washington Heights and hopes to become a criminal defense lawyer. "I've only met one boy in my class who is real sensitive. The rest, they're tough. If the girls let the guys know they don't like guys like that, maybe they would act different."

• • •

When it comes to the way things are between boys and girls in struggling places like East Harlem and Washington Heights, some difficult verities tumble from young lips. Gender stereotyping exists in suburbia, too, but the inner-city consequences fall harder and faster. At one end of the stereotype continuum is classroom posturing. At the other end are boys playing with real guns and girls playing with real babies.

Teachers, students and parents say that violence and parenthood at an early age are attempts to define true manhood or true womanhood in places where children are offered few other paths for self-definition.

"I think if girls got more involved in school and wanting to become something in life, they wouldn't get pregnant," says Jennifer Figueroa, 15, a ninth-grade classmate of Ms. Perez. She lives in East Harlem. "You feel like you're alone and that's when you turn to bad things."

"There isn't a lot of communication between boys and girls," Ms. Figueroa said. "The boys think the girls will like them if they've got a tough reputation, and the girls think the boys won't like them if they're too smart or if they don't act the way they want."

Queen Latifah, the rap performer, shouts, "Here we go, here we go," in her song "Unity," about the distance to be traveled for female respect. A group staking out territory is Girls Inc., the national research and advocacy group. Last year it started the New York Project.

In East Harlem, Washington Heights and the South Bronx — places with high concentrations of low-income girls with not much to do — the project offers girls-only classes for math and science experiments. The Girls Inc. researchers found that in some communities, recreation for girls consisted of watching the boys shoot hoops.

Their research also showed that in post-elementary grades there are diminished expectations for girls in math and science and that women represent only 15 percent of the scientists and engineers in the nation.

As the program expands, plans are to offer sexuality and health classes, substance-abuse prevention and competitive sports.

"The point is to give girls some vision of their own future," said Isabel Carter Stewart, the executive director of Girls Inc. "You want to be a chemist, a doctor? This is how you can do it.

"What we call smart is valued," Ms. Stewart said. "It translates as fun and energetic. We need to help them make the same translation when they go back into the classroom and to be more secure in what they're learning."

So far, Ms. Perez and Ms. Figueroa and more than 200 other young women in elementary and high school have attended classes in which they do things like play tag using math games, dissect animals or make flashlights. There is not enough space to accommodate all the girls who want to participate.

"I like the fact that it's hands-on activities," says Damary Bonilla, 14, a Central Park East freshman from East Harlem. "I like the fact that it's girls only, and we can express ourselves without feeling lower than anybody else."

"We don't have to do any boy stuff in here and they can't hit us. Boys like to fight and get in trouble," said Karen Riddock, who the other day stood in a room in the Claremont Neighborhood Center in the South Bronx with jars of muddy water and a dozen other little girls in long white T-shirts. She is 9 and in the fourth grade at Public School 55 in the South Bronx.

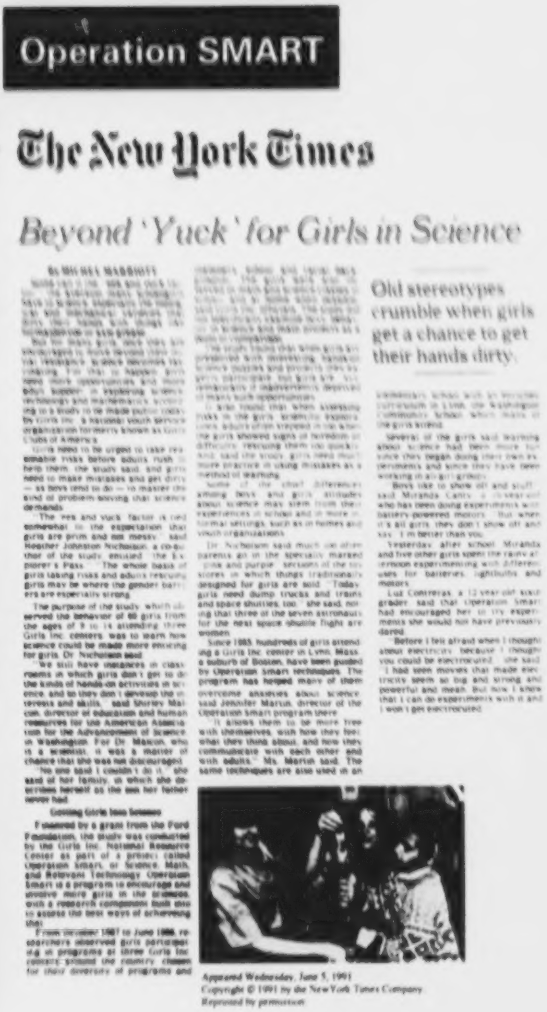
The task for her and her lab partners was to use coffee filters and whatever else was at hand to clear the water of mud.

Lisa Goodall, the director of the New York City Project, buzzed around the room offering advice but no answers. She encouraged the girls to think for themselves. Someone wrote "I Love Lisa" in blue chalk on the blackboard.

Ms. Goodall recalled that on a visit to a school, she asked seventh and eighth graders to use positive words to describe girls.

"They said 'Girls are pretty' and 'Girls are fly,' Ms. Goodall said. "When I asked the girls to pick out words that make them feel stronger, they picked out words like 'doctor,' 'lawyer' and 'intelligent.' "

*Here we go, here we go.*



## Operation SMART

The New York Times

# Beyond 'Yuck' for Girls in Science

Old stereotypes crumble when girls get a chance to get their hands dirty.

Appeared Wednesday, June 5, 1991
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girls inc.

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Research has shown that traditionally, girls drop out of the science and math fields while still in school. Programs like Operation SMART aim to change that. Teachers hope the interest sparked now will make girls feel more comfortable later on when competing for careers.

**

*KEYT-TV (Santa Barbara ABC affiliate) News Correspondent Kerrie Anna Criado, on "The 6 O'Clock News" October 19, 1991*

THE ATLANTA CONSTITUTION

# OutSMARTing the myth of math phobia

**EDUCATIONAL EXPERIMENT:** Science is fun for Girls Inc. members

**By Pat Burson**
Staff writer

Ashley Hart says math and science are her favorite subjects.

Officials at Girls Inc. of Cobb County are hoping to nurture the 9-year-old's enthusiasm through a program called Operation SMART — an acronym for Science, Math and Relevant Technology — and thus prove to other girls that they can excel in these courses.

"We're trying to dispel the myth that girls don't like math and science," said Janet Street, president and CEO of Girls Inc. of Cobb County. "Our research shows educators expect girls to excel in English and home economics and fashion education courses, but girls have not been motivated to excel in math and science because these have been seen as male-dominated areas."

Operation SMART, which is a nationwide program, has been used by Girls Inc. centers nationwide for the past five years and in Cobb County since last year.

The girls in SMART take part in classroom lessons and experiments. They also have taken field trips to such places as the SciTrek museum and the Weather Channel offices in Atlanta and Fernbank Science Center in DeKalb County. And they get to hear from professional women who are invited weekly to speak at the centers about careers in an assortment of non-traditional fields.

"We take every opportunity to talk to girls about math, science and technology," Ms. Street said. While only one person is coordinating the Operation SMART program in Cobb, she said, all staff members are trained to talk about math, science and technology in relation to other topics of discussion.

"We're trying to make it a way of life, so it's not something girls are afraid of, and they see it as fun and educational," Ms. Street explained.

She and her staff encourage the girls to explore, to get their hands dirty and not to worry if they don't get the right answer on the first try.

"Nobody ever gave me the opportunity to let me know that I liked taking things apart and putting them back together again," Ms. Street said. "When we have minor repairs around the centers, we're letting the girls do them. Wherever we go, we're going to allow the girls to navigate the trips. We're trying to get girls to use science every day as a way of life."

So far, Operation SMART has been a big hit with the girls, according to coordinator Cindy McDougald, who teaches science and math lessons at the Girls Inc. centers in Marietta and Austell.

"At first there was a little hesitation because they didn't know what it was," she admitted. [illegible] to learn it."

Recently, a group of 8- and 10-year-old girls were gathered around the counter at the Marietta center engaged in a variety of experiments exploring principles of physics and geometry. For these lessons, however, no textbooks were required. Instead, they used water, bubbles, fruit, plastic bags and other items to learn about water pressure, buoyancy and geometry, shapes and sizes.

"I like it because you see how everything works on the Earth," said Denise Matthews, [illegible]

Ms. Street said one of the goals of Girls Inc. is "empowering girls to be financially independent." One way to accomplish that is encouraging them to broaden their future career possibilities.

Ms. McDougald said she surveyed most of the girls before they began participating in Operation SMART. Initially, she said, most shied away from non-traditional jobs. But that appears to be changing.

"I want to be a scientist, a dancer, a plastic surgeon and a psychiatrist," chimed in a smiling Shekera Cook, 10.

Appeared Thursday, February 28, 1992
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There are many reasons why women don't pursue math and science. But the major one seems to be that girls don't get encouragement— not from teachers, not from parents. [Operation SMART] targeted at girls 6 to 14 years old provides [girls] hands-on opportunities to explore science and technology. They are urged to experiment and to make mistakes.

*ABC News Correspondent, Carole Simpson on "ABC World News Tonight" August 21, 1991*

The Washington Post

# *Gender Gap in Science*

THAT GAP in math and science achievement, the one that manifests itself first in the lower test scores of adolescent girls, persists throughout school and influences women's aspirations, has been studied and argued over at least since the advent of the No. 2 pencil. Is it in the genes or in the culture? Is it biology or bias that propels Johnny toward the computer and Jane toward the artwork? The definitive answer remains elusive, but some recent research in testing and behavior certainly suggests training can close the gap.

The Mathematical Association of America's Committee on the Participation of Women has compiled 55 reasons why too few women win at mathematics. All pertain to customs prevalent in places as different as nursery schools and doctoral programs. The committee cites the pervasive influence of sex stereotyping and the belief that mathematics is "not feminine." It also questions the validity of multiple-choice tests, which favor aggressive risk-takers. (Females perform better than males on "open-ended" math tests administered in the Netherlands, preliminary results indicate.)

Meanwhile, another research group has looked at girls at play and in the classroom and discovered that when they are offered encouragement and the chance to seek adventure they persist and perform well. A report of the National Resource Center of Girls Inc. (formerly Girls Clubs of America) found that "much more exposure to machinery and equipment, much more interaction with plants and animals, many more field trips to factories and laboratories and many more chances to get really dirty in the process of exploration are part of the prescription for interesting girls in math and science." A separate longitudinal study of high school students finds that the more math classes girls take, the better they do and the more the gender gap narrows.

Today, fewer than one-fifth of the nation's scientists and mathematicians are women. Yet more than half the new entrants in the work force between now and the year 2000 will be women. If this country expects to excel in science and math, and attract good thinkers and problem solvers to the work force, it's going to have to change the prevailing mind-set about girls and math.

Appeared Thursday, June 6, 1991

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The Huntsville Times

# Calculating careers

## 'Operation SMART' boosts girls in math, science

By MINDY KEYES
Times staff writer

Five girls huddle around a record player.

The girls peer at the player as if they're curious to see what new tune they've just heard. But the machine rests quietly, and the only music in the room is the singsong of the girls' voices.

The girls, ages 8 through 11, are about to take apart the record player to learn how it runs.

They are members of Girls Incorporated of Huntsville, and they're at the work table in the non-profit agency's Discovery Room. The room is one of the local agency's first attempts to apply Operation SMART, a national Girls Incorporated program designed to encourage girls to learn about science and math through hands-on projects.

The girls sort through a small red toolbox and grab screwdrivers and wire cutters. They set to work.

Nyssa Robies, an Oakwood College intern who oversees Discovery Room projects, and Alice Arrington, the local agency's executive director, ask the girls to identify the parts of the player.

The girls agree that colored wires connect different parts of the player, but they're not sure what the capacitor does. They hesitate when asked about the circuit board. And anything that they can't identify they call a battery.

But what they don't know doesn't stop them from looking, fingering, shaking, cutting, unscrewing and talking about what they know and think about science.

"That looks like ear wax," says Morgan Landers, 8, dipping her screwdriver in a dab of grease.

"And what does grease do?" says Ms. Arrington.

"Grease makes it slip so it will work," she says.

Bianca Williams, 9, cuts several colored wires, then pauses to say she's learning about electricity at school.

"We do magnetics and electronics and projects," she says. "I like this better 'cause you get to do experiments."

"I'd do this all day long if I could," says Daphne Martin, 10. But she adds, "I hope I leave before we have to put this back together."

Keila Ford, 10, says she's enjoying taking apart the record player, but she prefers math to science. She might be a doctor, but she wouldn't want to dissect a frog.

"Yuck," she says.

Kendria Odoms, 11, says she thinks science is important for people who want to be astronauts. She says she'd like to be an astronaut to learn about the planets.

Bianca says science is also important to teach doctors to operate on people with the help of computers. She says she's not sure if she wants to be a scientist, but she thinks anybody who studies enough can become one.

Ms. Arrington says Operation SMART (Science, Math and Relevant Technology) teaches girls the principle of scientific inquiry.

"They're learning to think through things," she says. "They're learning to ask how things work."

She hopes that the program will also inspire girls to pursue careers in science and math. But even if they choose other careers, she feels that the girls will be better decision makers with the use of scientific inquiry.

"The scientific inquiry method can teach you that (a mistake) is not a failure," she says. "It's an opportunity."

Ms. Arrington worries that too few parents and teachers encourage girls to study science and math because of traditional stereotypes about careers for women.

She says "How Schools Shortchange Girls," the recent report from the American Association of University Women, highlights the need for people and organizations to rethink attitudes about women's career roles.

The report says girls are not pursuing math- and science-related careers in the same proportion as boys.

Operation SMART can help fight that gap, Ms. Arrington says, by offering girls hands-on science experiments and reinforcing the attitude that girls interested in science and math are "cool."

Ms. Arrington says she has asked a local corporation for a grant to expand the program. She would like to introduce Operation SMART in local schools and hire a science educator to plan science projects.

She says she would also like to expand the range of science and math projects that the agency can offer.

The agency lacks materials for many experiments, she says. She is seeking donations of tools, magnets, microscopes, stick pins and old machines like radios and clocks. She is also looking for Discovery Room speakers and volunteers.

Ms. Arrington feels that the program is a "critical undertaking."

Women, who constitute more than 50 percent of the U.S. population, should be encouraged and prepared to hold as many "high-tech" jobs, she says.

The economy is an important reason to encourage girls in science and math, but an even bigger reason is their personhood, she says.

"I think they deserve (encouragement) because they deserve it," she says.

Girls Incorporated is a United Way agency that provides after-school and summer programs for girls ages 6 to 18. For more information about the agency or Operation SMART, call 539-0159.

> "They're learning to think through things. They're learning to ask how things work."
>
> — **Alice Arrington**
> Girls Inc. executive director

Appeared Thursday, March 19, 1992
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For more information contact

girls inc.

**Girls Incorporated**
30 East 33rd Street
New York, NY 10016
(212) 689-3700

**Girls Incorporated**
**National Resource Center**
441 West Michigan Street
Indianapolis, IN 46202
(317) 634-7546

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Girls Incorporated

**IN THE NEWS**

girls inc.

The New York Times

NEW YORK, THURSDAY, JANUARY 27, 1994

**Girls to Cortines: We Can Do Science, Too**

Girls who participate in a Girls Inc. after-school math and science program at Public School 102 on East 113th Street entertained Schools Chancellor Ramon C. Cortines yesterday to discuss their suggestions for making science and math more accessible for girls in the public schools. Mr. Cortines watched an experiment by, from left, Maria Diaz, Christina Ortiz, Delores Ortiz, Melissa Marquez and Zuleyka Gonzalez.

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Mrs. LLOYD. Thank you very much. That was beautiful testimony.

Dr. Failor, we look forward to hearing from you now.

Ms. FAILOR. Thank you. Chairwoman Lloyd, members of the committee, thank you for inviting me here today. I am Dr. Rebecca Failor. I am a member of the Board of Directors and Past President of the Math/Science Network. The Math/Science Network is a nonprofit membership education organization that was founded 20 years ago and whose mission is to promote the continuing development in math and science for all people with particular emphasis on women and girls.

The Math/Science Network is the founding organization and the national coordinator for the Expanding Your Horizons in Science and Mathematics Conferences.

In 1976, the Math/Science Network created Expanding Your Horizons Conferences to nurture 6th through 12th grade young women's interest in math and science, to promote math and science education to these young women, to expand their vision of their career options to include math and science-based careers.

Since the first Expanding Your Horizons Conference more than 300,000 young women have attended the conference. Also in attendance have been over 40,000 parents, educators including counselors, and these conferences are throughout this country.

In 1993 through 1994, which was our conference year that spans the same as the school year, there were 125 conferences and in 31 States, attended by approximately 45,000 girls. Each Expanding Your Horizons Conference is a grassroots volunteer effort. The efforts are supported by all the organizations seen at this table as well as many others. The local communities tailor the conferences to match the needs and resources of their own community.

The presenters at the conference come from not only the local communities but far-reaching areas and are members of organizations such as the American Women in Science, AWIS, and Society of Women Engineers, SWE. They are themselves female scientists, engineers, technicians, accountants, bankers, doctors, nurses and veterinarians. They serve as role models for the young women, providing them with the message that, Yes, you can do this, and they are brought in to represent the diversity that is present in the girls' own community.

Each conference include hands-on activities that are presented by these role models and designed to give fun experiences and can-do experiences to the young women so that they can say, "I can do this." And as Rich Stephens has said, when they can know they can do this they go away and want to do more and more and more.

Some examples of the fun workshops that they have are "Designer Genes," where the young women look through microscopes and study chromosomes and chromosomal splitting; "Don't Eat These Chips," about microchip technology; "A Heartbeat Away" about critical care medicine, critical care technology; and "You Are Such an Animal," veterinarian science, one of the very most popular among the younger girls.

Throughout the Expanding Your Horizons, the importance of math/science education is stressed, not just for math or science-based careers but for all of the life paths that these young women take.

Expanding Your Horizons Conferences are effective. Before and after surveys, both verbal and nonverbal, as you have seen with Rich's, show a tremendous shift in interest and attitude towards math and science. Teachers relate back changes in interest in the classroom and changes in interest in the signing up for the next year's courses. Most Expanding Your Horizons Conferences are in March, timed to affect the young women's decision for their next year's courses.

Repeat attendance at Expanding Your Horizons Conferences is tremendous. In some conferences, up to one-third of the students attending have been to an Expanding Your Horizons Conference before. They come willing and they come because they want to be there. But it is not just the students who are interested in math and science who come, because they are solicited from every area in the schools.

Women role models also benefit. The networking and friendships that are developed by working on Expanding Your Horizons I can testify last a lifetime. And especially for those women in the more rural areas where their contact with colleagues is limited Expanding Your Horizons has a major impact. Praise from Expanding Your Horizons Conferences have come from many sources. The Congressional Task Force on Women, Minorities and the Handicapped identified Expanding Your Horizons as an exemplary program. The American Association of University Women has identified it as a model program in their "Call to Action for Educational Equity" initiative.

But I think the following letter that is included in its totality in the testimony tells it best. It is from a teacher from Stockton, California, who brought 26 girls to the conference, and I would just like to read excerpts.

We brought some bright, self-motivated, responsible girls. We brought some bright, peer-motivated, irresponsible girls. I brought one girl who is trying to decide if she wants to join a gang or be a doctor. She is a natural leader, and if we can prevent her from dropping out we will probably catch 15 of her friends.

They are treated so well at the conference. The workshops are well set up, hands on multiple activities. You tell them you need them and you want them in so many direct and indirect ways. They talk to real women in real jobs and who are more convincing than I could ever be.

On behalf of their friend who might not drop out, I thank you. On behalf of the teachers who will see more girls in their math and science classes, I thank you. And as a teacher on the front lines who had a chance to see that there are people in the real world who care as much as I do, I thank you. And from all of the thousands of women across this country who work on Expanding Your Horizons Conferences, and on behalf of the Math/Science Network, I thank you too.

[The prepared statement of Ms. Failor follows:]

# Testimony to the U. S. House of Representatives

## Committee on Science, Space, and Technology

## Energy Subcommittee

**Dr. Rebecca Failor**
**Member of Board of Directors and former President**
**Math/Science Network**

**June 28, 1994**

Chairwoman Lloyd and Members of the Committee, thank you for the invitation to appear here today. I am Dr. Rebecca Failor, a member of the Board of Directors, and immediate past President of the Math/Science Network. The Network is the founding organization and national coordinators for Expanding Your Horizons in Science and Mathematics Conferences (EYH). *(Math/Science Network, Mills College, 5000 MacArthur Boulevard, Oakland, CA 94613, phone (510) 430-2222)*

### *The Math/Science Network*

The Math/Science Network is a non-profit membership organization of educators, scientists, mathematicians, parents, community leaders, and government and corporate representatives whose mission is to promote the continuing development in mathematics and science of all people, with particular emphasis on the needs of women and girls. Our major goal is to increase the participation, retention, and advancement of girls and women in mathematics, science, and technology.

The Network's programs are developed based upon the following assumptions:

- In order to increase the participation of women in mathematics, science, and engineering careers there must be an increase in the pool of qualified women.

- In order for young women to have the option to enter mathematics, science, and engineering careers, they need to choose to take the appropriate mathematics and science courses in high school.

- Intervention strategies are needed which increase the participation of girls in mathematics by nurturing enjoyment and confidence in mathematics, by connecting the value of mathematics to career opportunities, by providing career role models, and by actively encouraging girls to persevere in mathematics courses.

## *Expanding Your Horizons in Science and Mathematics Conferences*

In 1976 the Math/Science Network created Expanding Your Horizons in Science and Mathematics (EYH) Conferences as an intervention strategy, designed to nurture girls' interest in mathematics and science courses and to encourage them to expand their career visions to include science and mathematics-based careers. Since the first conference was held at Mills College, Oakland, California in 1976, more than 300,000 sixth through twelfth-grade young women and approximately 40,000 parents and educators have attended EYH Conferences. In the 1993-1994 year there were 125 individual conferences held in 31 states, reaching approximately 45,000 students.

**1994 EYH Sites - Is There One Near You?**

| | | | | | |
|---|---|---|---|---|---|
| 3 | Arizona | 1 | Michigan | 1 | Ohio |
| 11 | California | 1 | Minnesota | 1 | Oregon |
| 10 | Colorado | 2 | Missouri | 3 | Pennsylvania |
| 6 | Florida | 13 | Montana | 1 | Tennessee |
| 1 | Iowa | 3 | North Dakota | 13 | Texas |
| 2 | Idaho | 3 | Nebraska | 1 | Virginia |
| 2 | Illinois | 1 | New Hampshire | 18 | Washington |
| 2 | Indiana | 1 | New Jersey | 7 | Wisconsin |
| 2 | Kansas | 5 | New Mexico | 1 | West Virginia |
| 1 | Massachusetts | 2 | Nevada | 3 | Wyoming |
| | | 5 | New York | | |

Each Expanding Your Horizons Conference is unique, because they are designed at the local level, by the women in that community, to meet the needs of their students, and use the resources to which they have access. A typical conference is held on a Saturday at a college or university campus. This location gives many young women their first experience on a campus, letting them imagine themselves there for higher education. The attendance at EYH conferences varies from 50 to over 1200, with typical attendance between 200 and 400.

### *Sometimes, Famous Keynote Speakers*

The agenda typically starts with registration followed by a keynote speaker who encourages the young women to explore new career ideas, to understand the importance of mathematics and science education, and to keep their options open. Over the years several pre-eminent U. S. women of science have spoken at Expanding Your Horizons Conference, including Sally Ride and other female astronauts, biochemist Arlene Blum, who lead the all-women expedition to climb Annapurna; and Mitzi Phillips of the Gorilla Foundation, where the gorilla Koko learn sign language. The Math/Science Network helps local organizers to find speakers for their EYH Conference.

*Always Fun Hands-on Workshops*

Each Expanding Your Horizons Conference includes hands-on workshops where women, who themselves have active careers, work with 10 to 20 students on a project, experiment or activity. Each workshop is designed to give the girls a "can-do" attitude and a fun, learning experience in science, mathematics, engineering, medicine, or any related field. Examples of these workshops include "Designer Genes" (classify genes using a microscope), "Are There Stars in Your Eyes" (assemble and use a telescope), "The Great Animal Detective" (veterinary diagnostics), "Mutual Attraction" (the properties of magnets and magnetism) to identify a few. Each year new, exciting, and fun workshops are developed by women from coast to coast. The Math/Science Network provides lists of workshop ideas to the EYH organizers each year.

*Career Information*

During the workshops and at programs called career discussions the women who are serving as role models share information with the girls about themselves, their careers, their lifestyles, and work/family issues. This includes information on the necessary training for the career, the best and maybe, worst, parts of the career, and a description of a typical day on the job. Each woman is encouraged to connect with the young women to allow them to see themselves in that career, to break down the barriers of "Someone like me can't do that", or "I'm not smart enough for that", "Only nerds like math/science", and "Women don't do that kind of work" types of thinking. The Math/Science Network provides information to aid the presenter in "relating" to adolescent girls, explaining typical needs and concerns of girl in this age group. Some EYH Conferences hold "Career Fairs" where local businesses, schools, and professional organizations have display tables and provide information to the students.

*Parents and Educators Programs, too*

Many EYH Conferences include special sessions for parents and educators to provide them with the information they need to better foster and support interest in mathematics and science. The adults are made aware of the factors that push young women away. Materials from AAUW's "Shortchanging Girls, Shortchanging America" are shared, examples of negative messages in the media are discussed, and the forces of peer pressure are examined. Positive activities and messages are taught and reinforced. Part of most adult programs is information regarding access to and funding for higher education. Parents are made aware of how to help their daughters get into colleges and about the numbers of private sector scholarships that go unawarded every year. Investment counselors are often a big hit when they explain tax-saving ways to save for higher education. The role models are very willing to share their experiences with the parents and educators, giving real life examples of the subtle, and not so subtle, ways they were encouraged and discouraged on their road to a science career. And as is part of all EYH experiences the importance of mathematics and science education for career options is emphasized. School counselors and advisors are one of the target audiences for this information. The Math/Science Network has lists of program options for adult portions of EYH Conference. Though Parent and Educator sessions are a valuable addition to EYH Conferences the focus of the day is on the young women and their experiences.

Targeting parents and educators helps bridge between short-term enthusiasm and long-term actions. We find that the parents and educators are as eager to learn about ways to support young women as the young women are to be supported.

***Time Flies When You Are Having Fun***

The Expanding Your Horizons Conference day typically ends with a closing session. The messages of the day - new awareness of the number and variety of careers in science, mathematics, and technology; the importance of science and mathematics education, especially at their age, to keep their options open, and the "women can do", "I can do", and fun experiences with science and mathematics - are reinforced. The closing sessions often include the awarding of prizes for participation in games during the day that are designed to get the students to ask questions and explore the opportunities at the Conference. Many sponsors tell us that the girls do not want the day to end, and "boo" when told the day is over.

## *Grass-Roots, Local Efforts*

Since 1988 the number of Expanding Your Horizons Conference sites has nearly doubled. In communities across the United States, some in Canada, and a few outside North America, people have recognized EYH Conferences as a way to make a difference for their young women. Local organizing groups include university staff, such as the Colorado School of Mines, staff from a local industry or government agencies, such as Department of Energy laboratories, professional societies, such as American Chemical Society Headquarters, Washington D. C., civic leaders, and parent-teacher groups. The State of Washington has the largest number of EYH Conference sites, each supported by local American Association of University Women (AAUW) branches.

The organizers are most always volunteers, leveraging their efforts and diverse talent against limited funding that most EYH Conference sites face. Funding for most local EYH Conferences is through local business donations, especially in-kind donations, especially for facilities, printing, food, and prizes. (There are a few sites with more formal funding sources, such as AAUW Community Action Grants, National Science Foundation grants, rural community assistance grants, and some sites with a paid Conference leader.) The average budget for an EYH Conference is $5,000 plus a small registration fee paid by each student.

***Valuing Diversity***

The local organizing committee tailors the EYH Conference to their community. The facilities, availability of women to serve as role models, as well as the economics of the area are all factors that affect the nature of an EYH Conference. Of special focus is the diversity of the students in the region. The Math/Science Network has special materials to assist the organizers in evaluating their local population, recruiting to assure diversity in the committee and role models, and understanding the special needs of some of the young women in their community. A special program for African American young women in Greensboro, North Carolina was run by the Math/Science

Network. A number of sites have special programs for Native American young women with high attendance. Recent statistics show that approximately 24% of the students attending EYH Conferences are from minority ethnic/racial groups.

*Rural EYH Conferences Have Flourished*

Approximately 50 EYH Conferences are in rural or small town areas where the traditional opportunities for access to science museums, college enrichment programs, and industrial partnerships with schools are not as prevalent. In these areas the local committees report that EYH is one of the few opportunities where the students see women in science, mathematics, and technology-based careers. Often the students and role models come hundreds of miles to participate in EYH conferences. In North Dakota one of the largest EYH Conferences is held, drawing over 800 young women from North and South Dakota and Minnesota. In Montana and Wyoming female pilots in the Department of Forestry fire fighting teams fly in to work on the EYH Conferences. Local utilities and industries are especially supportive, since they find it difficult to recruit skilled workers in the sparsely populated, often agriculturally-based areas. These EYH Conferences tailor their programs to the needs of the community, by including career opportunities that allow the young women to remain in the area and have a career.

*The Women Benefit Too*

An often overlooked benefit of the Expanding Your Horizons in Science and Mathematics Conference program is networking between the people who work on the Conference. For many women work on EYH committees provides a rare opportunity to interact with a new group of people, who are supportive of women in science and mathematics-based careers. Teachers and educators they learn from the role models about careers that they may have been unaware. Women who may not have had many female peers on the job can interact with those with similar backgrounds and experiences. A number of women, especially from rural areas, say the Expanding Your Horizons experience is the one place where they can interact with other women scientists in an atmosphere of pride and nurturing. In my earliest experience as a role model at an EYH Conference, the sense of pride from the women was so tangible that it was overwhelming. Experience has shown that this networking has led to new career opportunities, a support network, and long lasting friendships.

## *Why Expanding Your Horizons?*

Research for the past twenty years, from Lucy Sells report "Mathematics: The Critical Filter" to the reports supporting AAUW's Educational Equity Initiative, have called for active intervention strategies. The report "How Schools Shortchange Girls" from the AAUW Initiative states "Local schools and communities must encourage and support girls studying science and mathematics by showcasing women role models in scientific and technological fields, disseminating career information, and offering "hands-on" experiences and work groups in science and math classes. Local schools should seek strong links with youth-serving organizations that have organizations that have developed successful out-of-school programs for girls in mathematics and science."

### *High Praise for Expanding Your Horizons*

Praise for the Expanding Your Horizons in Science and Mathematics Conferences has come from many sources. The 1989 Federal study reported in Changing America: The New Face of Science and Engineering by the Interagency Taskforce on Women, Minorities, and the Handicapped in Science and Technology identified Expanding Your Horizons in Science and Mathematics Conferences as an Exemplary Program. AAUW President Sharon Schuster called EYH Conferences a "model program" in a "Call to Action" 1992 presentation in Livermore, CA. In 1993 Dr. Cherrill Spencer, member of the Board of Directors of the Math/Science Network, received the Institute of Electrical and Electronic Engineers "Spectrum" Award for Pre-college Innovative Math/Science Education for her extensive work on EYH Conferences. Funding has been provided to the Math/Science Network for continued support of the Expanding Your Horizons program from organizations such as NASA-Ames Research Center, American Association for Artificial Intelligence, Intel Corporation, the National Science Foundation, American Association for the Advancement of Science, and the Coleman Foundation, to name a few.

### *Flexibility Allows EYH to Meet Varied Needs*

The flexibility of the EYH format allows it to be successful for most every organizing group, community, and budget. In each and every program the fundamentals of promoting mathematics and science education, interaction with positive female role models who are in science and mathematics-related careers, and fun, can-do experiences with hands-on workshops form the basis of the EYH experience. In 1990 a special Expanding Your Horizons for the Environment was held using the basic EYH model but focusing on career fields that are important to environmental protection, such as hazardous material handling, environmental chemistry, biology, and environmental law. In several areas the day-long EYH model has been extended to a week-long summer camp. At some sites trips to the role models work place are highlighted. Some districts have EYH Conferences during the school day.

### *Easily Combined with Follow-on Programs*

Though the basic Expanding Your Horizons Conference is a short term activity, it is well-suited to follow-on activities that nurture the beneficial experience of the Conference. As an example, mentoring programs after the Conference connect students with the role models from the EYH Conference they attended for continued interaction, especially visits to the woman's workplace. Expanding More Horizons was a special project, funded by the Ford Foundation, to combine the traditional Expanding Your Horizons Conference with a mentoring program in Greensboro, North Carolina. Some school districts invite EYH role models to the schools after the conference to continue the interaction. Proposals for a national EYH newsletter, to be sent to young women after they have attended an EYH Conference, have been well received, but to date have not generated a funding mechanism.

### *What the Math/Science Network Provides*

The Math/Science Network serves as the national coordinators of the Expanding Your Horizons in Science and Mathematics Conferences. In that capacity the Network is responsible for national publicity, national data collection, promoting and encouraging increases in the number of EYH sites, providing on-call assistance to local organizing committees, coordinating orders of EYH support materials, and several packets of organizational and hand-out materials.

#### *Organizational Materials*

To assist each Expanding Your Horizons site plan for their Conference the Math/Science Network provides three packets of conference materials. The first packet contains information about registration of the conference site into the national organization, individual and corporate membership in the Math/Science Network, and establishment of a pass-through account at the Network so that individual sites may take advantage of the Network's non-profit status for fundraising purposes. The second packet presents vital organizational material, from general background about EYH and the Math/Science Network, to specifics concerning finances, public relations, conference registration, conference evaluations, and tips on workshops. There is further information for conference organizers, information for presenters, sample certificates of appreciation, as well as helpful hints on last minute problem solving.

The final mailing provides a substantial amount of information for students and adult packets that are received at the Conference registration. This material includes mathematics games, science puzzles, information on "How much math do I need to become a ________", starting salaries for a variety of careers, places to write for free information on careers. Adult packet information includes material on college admission and scholarships, articles on gender equity, and helpful hints for supporting young women's interest in mathematics and science.

The materials provided by the Network are continually being improved. This year we hope to receive special funding for a major revision in some of the materials. Limited funding for the Network's national coordination efforts have hampered the our ability to provide additional support to the local conferences.

#### *Collaboration with Similar Organizations*

The Math/Science Network encourages collaboration with other organizations involved in young women's education. The Math/Science Network had its start at Mills College, a women's college in Oakland, CA, and has recently accepted in invitation to be housed in the newly renovated Mills Hall. An annual EYH Conference on the Mills campus introduces over 300 young women to the opportunities of single gender higher education. Nancy Kreinberg moved from her early days with the Math/Science Network to the EQUALS program as part of the Lawrence Hall of Science. EQUALS Family Math activities are a part of many EYH Conferences and members of the EQUALS staff serve on the EYH National Advisory Committee. Professional organizations, such as the Association of Women in Science, and the Society of Women

Engineers, are outstanding sources of role models for EYH Conferences and provide materials for the students' packets. The Network has had several collaborative interactions with educational programs in the American Association for the Advancement of Science (AAAS), Department of Energy, and the National Science Foundation (NSF).

### *National Workshop for EYH Conference Coordinators*

In 1992 the NSF funded the first National Workshop for EYH Conference Coordinators, bringing 200 people who have been part of EYH Conference organizing committees or were interested in starting EYH Conferences to a 2 1/2 day meeting to share ideas, experiences, and improve the EYH experience. Included were women from AAAS' cooperative program with the Girls Scouts, Girls Incorporated "Operation Smart" and AAUW's Educational Equity Initiative. A summary report of the workshop was prepared and is used to aid new site coordinators.

## *Is Expanding Your Horizons Effective?*

Every EYH Conference includes surveys of the young women to determine their response to the day's activities. The general impression is always positive. They always learn something new, they always have a good time. Not every experience is perfect but the fraction of students who have attended an EYH Conference before is as high as one-third at some Conferences.

### *Before and After Surveys*

A variety of types of "before and after surveys" show a shift in the perception and interest in science and mathematics. A valuable non-verbal indicator is comparing drawings that students submit in response to the questions "What does a scientist look like?" or "What does a scientist do?". The "before" pictures are invariably men, in white lab coats, with foaming beakers and test tubes and bombs exploding. The "after" pictures are mostly women, very attractive and stylish, with big smiles, doing everything from looking at the stars through telescopes, to improving medical equipment, to designing a bridge. One of my favorites depicts a pregnant geologist in the field setting up a seismograph. Verbal surveys show a similar shift in perception, as well as an increased understanding of the value of mathematics and science classes to their future. There is typically a big shift in response to the question "How many math and science classes in high school do you need to be successful after high school?"

### *Students' Comments*

The following comments, made by students who attended an EYH Conference at the University of Nevada, Las Vegas, are typical of those from other Conferences:

"I like the way the speakers told us about how important is to stay in school."

"This was a very good experience that helped me to realize that potential I have as a woman in higher-level jobs."

"I think it was fun as well as educational. I was deciding to become a pediatrician but with the information I received today I think I will become a health physicist."

"I want to become a marine biologist, and I found out more steps I must take to reach my goal, including more math classes than I thought."

### *More Longer-Term Studies are Needed*

However, as scientists, such anecdotal information, while heartwarming, is not quantitative. It is a goal of the Math/Science Network to obtain more scientific data regarding the effectiveness, short and long term, of the Expanding Your Horizons Conferences. Funding for large scale and longitudinal studies has been difficult to obtain. The Math/Science Network believes that lack of ability to document the effectiveness of the Expanding Your Horizons Conferences reduces the funding for the national and local program.

Some studies do exist. From 1980 to 1982 a study was performed to investigate the effectiveness of the conference over the year following six EYH Conferences in the San Francisco Bay Area. The Conferences are found to have a profound effect on the young women's mathematics education plans, career aspirations, and self-initiated science and mathematics activities, immediately after the Conference. Later in the year the students who attended EYH Conferences were found to have higher enrollment in non-required mathematics classes than the control groups. A significant increase in self-initiated career-related activities was maintained for the older students who attended EYH conferences.

In 1990, The Effects of a Short-Term Intervention Program on Future Participation in Math and Science, (J. A. Tomhave, Masters Thesis, University of North Dakota) compared young women who had registered for a 1980 EYH Conference, one group who had attended the Conference with a group could not attend due to a blizzard blocking their access. Her research showed that attending the EYH Conference had a long-term positive influence on the participants. Young women who attended took more advance mathematics and science classes in high school, planned to continue higher education, and rated their attitudes toward mathematics and science more positively than those who did not attend the Conference.

The Math/Science Network believes that more studies of this type, and especially longitudinal studies are required to adequately evaluate the effectiveness of and fine-tune this type of intervention strategy.

### *Praise from a Teacher*

But the lack of data at this point should not deter us. The following letter is an expression of the value that one teacher placed on the Expanding Your Horizons experience her students had when they attended a conference held at the Pacific Bell Administration Center in San Ramon, California.

"We brought 26 girls from Edison High School in Stockton. They could *never* have imagined such a beautiful building existing. They could not *imagine* that they ever could work in such a place. We brought some bright, self motivated, responsible girls. We brought some bright, *peer* motivated, blown by the most popular breeze, irresponsible girls. I brought *one* who can't decide if she wants to join a gang or be a doctor. She is a natural leader. If we can prevent *her* from being a drop-out we can probably catch 15 of her friends. One bus load of undirected talent and energy came to the conference. We lose close to 1/2 of our freshmen. Some of them were on the bus. I bet we don't lose them now.

They are treated so well at the conference, the workshops are well set up - hands on, multiple activities, friendly presenters, helpful guides, beautiful environment, good food. They get $50.00 worth of Expanded Horizons in the first hour. You tell them that you need them and you want them in so many direct and indirect ways. They talk to real people in real jobs. You are more convincing than I could ever be.

On behalf of their friends who may not drop out, I thank you.

On behalf of the boys with whom we promised to share the information, I thank you.

On behalf of the people in the "drop-out prevention program" who will not realize you are the reason for their success, I thank you.

On behalf of the teachers who will see more girls in their science and math classes, I thank you.

On behalf of the girls who will understand later on, I thank you.

As a teacher on the front lines, who had a chance to see that there are people in the real world who care as much as I do, I thank you.

For the organization, for the volunteer time, for the facility, for the workshops, I thank you.

Thankfully and sincerely,
Dianne Connelly
Edison High School
Stockton, CA 95206"

From those of us who also believe in Expanding Your Horizons in Science and Mathematics Conferences, I thank you.

Mrs. LLOYD. Just beautiful testimony. All of our witnesses have been wonderful today. Don't you in the audience agree? It has just been a wonderful, wonderful hearing. All of you have just been excellent. There is no way we would have had better testimony today.

I know it took a lot of time to prepare this and to work to be here. But I think it is certainly a very valuable hearing, and I want to thank all seven of you that have participated in our hearings today.

I want to follow up on a thought that—expressed by the last panel that many of the barriers that women face are as a result of their social values, whether it be home or the classroom, and the attitude of their peers.

What do you do in your programs to address these issues? And then what can we do to change the attitudes and stereotypes held by the men? When can we come in and say to the male students you shouldn't do this anymore?

Dr. Failor?

Ms. FAILOR. In Expanding Your Horizons we have a parents and educator organization—part of the conferences too, and we find that many of the parents coming are fathers who are looking to ways to be supportive of their students, and we find that the fathers need to understand ways that they can be supportive.

But we also feel that role modeling is an ideal way, because young women see older women like themselves, and if the life stories of these women are told, the young women make connections and find out that they can follow this path.

When I was growing up—I have my Ph.D. in nuclear engineering, and I thought I was very weird because I wanted to go into math and science. And for these young women to see that you do this, and these are "normal" people and not superheroes, not superwomen, they are very normal women, it provides them with an incentive to go forward and stops—provides them with information to counteract their peers and to counteract some of the messages they receive outside.

Mrs. LLOYD. Dr. Malcom? Any of you that want to respond.

Ms. MALCOM. I would just say that the program Girls for Science that we did with the Girl Scout Council in North and South Dakota and in Minnesota utilized the mechanism of trainer of trainers, which meant that we were training trainers and training staff and they trained leaders.

And a lot of these adult leaders are moms. I mean they are parents. They are there in the community. They are interacting with other parents all the time. And so when these women who are a part of the community were overcoming their own anxiety and interacting, this basically sent a large message to them. They were provided with information, basic information about what kinds of math/science courses were appropriate, and these kinds of things that they could include within their own counseling, within their own kinds of interactions.

There was also the identification of resource people in those local communities who could participate in the kind of career activities that were described by the representative from the Math/Science Network.

But another crucial thing that we found was that there were planning councils, local planning councils of representatives from business and from industry and from the local community, and those had a lot of dads on them as well as other people who represented local industry and business and higher education, and they understood and came to understand even better the connection between science and mathematics and being empowered by these fields and the economic consequences for those communities as well as for those individual young women, and they became advocates.

And I am sure that you know—I mean I have daughters, and if they want to go some place, you know, I have to be the carpool person. And when parents are involved in that kind of activity to get them to the place for their Scout meeting or to get them to the place for their exhibit or for whatever project they are working on, you just kind of get sucked into this.

And so through a lot of the kind of informal contact between the parents just working with their own daughters as they were pursuing badge-related activities it just spread. It spread throughout the community, and it raised a lot of interest on the part of the dads because it was science, math and technology. That it was, in fact, dealing with some critical issues.

So, while you can target the parents in the community directly, and through the spin-off activities that affect the larger communities such as jamborees or things like this, and that is a part of it, I think that the kind of indirect responsiveness where a community kind of gets caught up in the spirit of this kind of activity really is something where you have to see it to kind of believe it. But it happens.

Mrs. LLOYD. That is beautiful.

Ms. Kass.

Ms. KASS. At Girls, Incorporated, our mission is really at two levels. One is to help change opportunities for girls and change the skills that they are able to receive, help build their skills. The other part is to change the world that girls live in. So that means there are affiliates locally throughout the country that are working on committees and task forces such as those that Dr. Malcom mentioned, and they are changing those ideas and issues in their communities for girls.

On the other side, we have girls who are actually out in their community doing all kind of experiments relating to science and technology. It might be testing the water in their community. Members of the community see that. They see girls and young women taking action. They see them using math and science tools and techniques, and they see those changes. So, girls themselves are part of changing the ideas of both men and women and other institutions that want to try and keep girls in boxes.

Mrs. LLOYD. Mr. Stephens?

Mr. STEPHENS. One of the programs the Department sponsors is for very bright young men and women. In fact, it is one of two programs we sponsor that really deal with students that are already going to go on into science and math no matter what we do to them in our laboratories.

But this particular program brings in a collection of students from every State and they spend 2 weeks working together. And it is interesting to contrast programs for physicists, for physics students, you really see exactly the stereotypes we heard about earlier today: aggressive behavior on the part of young men; young women, if they are there at all—there aren't too many of them interested in physics—tend to be much more passive. And our scientists tend to be much more aggressive by bringing out the young men, frankly.

Programs that deal with life sciences tend to be the other way around. Far more women in life sciences, much more collegial, much more interaction among them. And so naturally I observed these two groups of students in physics and life science and see how they came out of their different backgrounds, and it comes right back to the point made earlier.

Teachers are absolutely critical to this process. If you don't engage a young woman in her class experience, then whether or not she may really have the ability, she's not going to ever be told that she has the ability.

So role modeling is fine. We do a lot of that. But it really does come back down to how you can help teachers understand that they really need to deal with the entire class, not just those who are more aggressive in answering and raising their hands for questions.

Mrs. **Lloyd**. Well, you have discussed the fathers and adult males. But how do we change the attitude of the young men? When they can see there is going to be female scientists, do you think they will stop the harassment of the women?

Mr. **Stephens**. If I might add, I think we have a number of women in this room who work for various agencies, and I know—and I suspect that Dr. Failor has some interesting stories about her graduate school experience. She was probably the only woman in nuclear engineering, I suspect, and I suspect she has some interesting stories to tell, and that is part of the problem.

As you move on into graduate school, it is much more competitive, much more aggressive, and a woman may very well suffer because of that, lack of background way back in terms of the ability to jump right into a discussion and try to do as much as what the men are doing.

And it is an issue that all agencies including our own, and certainly our laboratories do have glass ceilings problems. We have to constantly fight that perception that a woman can do science but can she move on up into management channels.

And this Secretary, I might say, and this Department now clearly show that it can be done. Hazel O'Leary is not a shy, inarticulate person. She literally deals with these issues every day. And half of our political appointees now in the Department of Energy are women. They are superbly prepared for their jobs.

So, we no longer have the excuse: I am sorry. We cannot find women and people of color to do these jobs. They are there. Believe me, they are there.

Mrs. **Lloyd**. They are on the scene.

Mrs. **Lloyd**. Mr. Baker?

Mr. **Baker**. Thank you, Mrs. Lloyd.

I think something ought to be pointed out about the labs and the Department of Energy and what good they do in spreading the word for science.

I am spoiled in the Livermore area having both Sandia and Livermore National Laboratories roaming through the school districts acquainting kids at a young age to the wonders of science. So, we are trying to do that through my office also, to allow them to know—is it the Columbine Program where they—we just had the moon shots all the way around the moon. We took that out into the junior high area where they were using computers to see various parts of the moon close up on computers, going to the wall map and finding their crater or their particular indenture in the moon on the map. Now, very exciting to bring science to kids.

Mr. STEPHENS. Let me interject, Mr. Baker—

Mr. BAKER. Surely.

Mr. STEPHENS. One of those laboratories that you represent did a survey of press coverage and—it was Lawrence Livermore, found that of all the press coverage of the Livermore Laboratory about 20 percent dealt with science education. Of all the good press that the laboratory got, 80 percent dealt with education outreach programs at the laboratory. So, yes, there is a lot that is going on and oftentimes we don't well articulate it.

Mr. BAKER. Not well covered. We are so interested in looking for Chernobyl and not enough about junior high school and how science relates to the future.

A couple of quick questions. Does genetics play a role? If you have artistic parents will you become more likely to become artistic if you are scientific in your family would that be passed down? Is there any—does anyone have any information that—

Ms. MALCOM. The only thing that I can say is that one of the things that is quite clear is that if you have scientists in your background that they are liable to have—you are liable to have a lot of science in your life. Your discussions at the dinner table. Your visits on vacation are going to include science museums because that is your parents interest.

And I think that that is probably as strong a motivating issue and a correlation as we can get, and that is that where is your access to real models about what science happens to be or what art is or what music is. If you have an artistic parent or musical parent you are liable to be able to start music training at a very, very early age because they are going to value that and they are going to make it available to you.

Mr. BAKER. But it is interest more than inherited.

Ms. MALCOM. I think that is strongly interest and it is also strongly the ability to provide guidance in the area, and I think that is where we end up with so many problems. You can get into this kind of vicious cycle because there are so few—for example, because there are so few people of color, the access to the advice that you are liable to need in order to know how to get into science and engineering is going to be severely limited.

And unless you can specifically target kids who have that interest to make sure that they get the advice and the guidance that they need, and the experiences at the time that they need them, then you are liable to lose them. Because it is not going to be clear how to get through that system.

Mr. **Baker**. I have never had science in my background and I am roadkill on the supercommunications highway.

[Laughter].

Mr. **Baker**. So I think it does have something to do with left brain, right brain.

But the question was really how do we find children with aptitude at a young age and then begin to nurture that?

And I imagine testing is more effective than genetics, but I wonder if that was going to help us at all. Because we have to find the young women very young and then begin to nurture the interest that they have in these areas.

My daughter thought that algebra and geometry were alien systems and she didn't want any part of them. And once I broke it down and showed her that it made sense, that there was an end to it and it all balanced she did very well. But right off the bat that is just something that she didn't want to be interested in.

It because I wasn't interested or somebody else was giving her stereotypes. She just wasn't interested. And there is got to be a way to find people who have certain talent and then begin nurturing that.

Ms. **Malcom**. But I hate to tell you this. I haven't met a baby yet that wasn't a natural scientist. Little kids are really into it. They are really into it. They are exploring their environment. They are finding out. They are asking questions of their environment, and they are really trying to know what is making things work.

But, as we progressively get through the system, that is when we start to lose it. That doesn't get nurtured. It doesn't get fed. There is no outlet for it.

We, what is it—we come here headed in that direction, probably until something turns us aside.

Ms. **Kass**. I think that it is important for us to recognize that it is not something wrong with the girls. That it is the opportunities that they receive, and the people who are working with them to make math and science fun and interesting and to connect the principles to something real.

So, it is not how do we finds those girls who are interested. How do we develop that interest in all girls—and all children, for that matter.

Ms. **Stutsman**. Just to play off of that a moment, at NSF we believe that all children can and will learn science and mathematics if they are encouraged to do so, and if they are expected to learn to do so. And so that goes along with Ms. Kass's comment.

And we believe that very firmly, and it is playing out in all of our large systemic efforts. We just don't expect children to want to fail, and we don't expect them to do so.

Mrs. **Lloyd**. Thank you very much, Mr. Baker.

Mr. McHale?

Mr. **McHale**. Madam Chair, I thank you. I was delayed at another hearing in the Armed Services Committee and I regret that I missed the opening testimony of our witnesses.

I don't have any questions for them, but I certainly have heard the brief portion of their testimony that has occurred within the last few minutes, and have found it to be very valuable.

I thank you for your testimony and look forward to any additional comments that you might have.

Mrs. LLOYD. I want to thank all of you for being here again. And I want to ask permission to provide additional questions that we might think of later that we would like to be made a part of the record.

Again, it is excellent testimony. We hope that we can build on this hearing and really do a lot with the information that you have given me, your success stories and your advice. It has certainly enriched my life today, and I thank you very much.

If there is no further comments, I would like to thank the staff for their hard work. Rose, you did a beautiful job. All of you have done a good job, and I thank you very much for getting the hearing together.

If there are no further comments, the subcommittee stands adjourned.

[Whereupon, at 3:50 p.m., the subcommittee was adjourned.]

# APPENDIX

Center for Research
on Women

August 26, 1994

Representative Marilyn Lloyd
U.S. House of Representatives
Subcommittee on Energy
Committee on Science, Space, and Technology
Suite 2320 Rayburn House Office Building
Washington, DC 20515-6301

Dear Representative Lloyd,

I am enclosing answers to the questions posed following my June 28 testimony. Dr. Patricia B. Campbell joined me in responding to your questions. We hope our responses are helpful.

Thank you for your commitment and energy on behalf of girls and women.

Sincerely,

Susan Bailey

Susan McGee Bailey
Executive Director

Wellesley College
106 Central Street
Wellesley MA 02181-8259
Telephone 617 283 2500
Facsimile 617 283 2504

## RESPONSES TO QUESTIONS FOLLOWING DR. SUSAN MCGEE BAILEY'S TESTIMONY AT THE HEARING "WOMEN AND K-12 SCIENCE AND MATHEMATICS EDUCATION" ON JUNE 28, 1994.

These responses have been developed in collaboration with Dr. Patricia B. Campbell.

1) What are your views on teaching strategies which emphasize that girls learn more effectively in a cooperative, less competitive environment. Is this a good approach? What is the effect of this strategy on competitive girls and cooperative boys?

Teaching strategies should be based on individual learning styles rather than stereotypical ideas of female or male modes of learning or thinking. As the question indicates there are girls for whom competitive situations are very comfortable and boys for whom cooperative work groups work best. It is important for all students to have both cooperative and competitive skills. It is good to play to people's strengths, but it is also important to strengthen their weaknesses.

Teaching strategies also depend on the subject matter content on which the teacher is focusing. Some skills are successfully taught using competitive techniques while others lend themselves more readily to cooperative techniques.

Teachers need better training in how to use a variety of teaching strategies. Much of what is often called cooperative learning is actually competition between groups -- an effective technique in some instances, but not a truly cooperative exercise.

While the use of a variety of techniques is important, there must be some core rules regardless of the techniques used. These include insistence upon equitable student/student behavior and treatment that does not include harassment and "put downs" and equitable distribution of teacher attention and assistance.

2) You stated in your testimony that girls' interest in math, science, and engineering increased dramatically from 1970 to 1980, but that since 1980, girls' interest has remained constant or even decreased slightly. What is the cause of this decline?

There is no hard data available with which to answer this question. Among our best guesses are the following points: Between 1970 and 1980 some of the barriers to women's participation in engineering and physical science programs were removed. More programs were open to women; sex discrimination was outlawed. A number of women who were already interested in the fields but, who in an earlier time would have been unable or unwilling to deal with the existing barriers, found it possible to pursue their dreams and went into these fields. The same kinds of extremely interested women continue to go into these fields. What we haven't done is interest, to the point of entry to the fields of math and science as they exist, additional women, nor have we redefined the fields in ways that might attract increased numbers of women (and men).

3) With math, where there is a right answer and a wrong answer, it seems straightforward to measure achievement and progress. How is science achievement measured? How are gender differences in math and science achievement interrelated?

In arithmetic there are clear right and wrong answers, in more advanced mathematics more often than not there are fewer clear answers. There may in fact be multiple right answers or no right answer. Simplistic measures of mathematics do not provide us with the most useful information and simplistic definitions of math as computation are insufficient. Thus, measuring both mathematics and science achievement is complex.

Science achievement measures are in flux and moving toward performance testing.

Mathematics and physical sciences "march" hand in hand. Math is an integral component of the physical sciences and engineering. In the words of one physics teacher, "physics is math made practical." Math is less related, but not unrelated, to the biological sciences. The lessor dependence in mathematics maybe be part of the attraction of the biological sciences for women and girls.

4) The data you presented shows that the situation for girls is improving in math but getting worse in science. Why do you think this is so? Are there specific methods to decrease this gap among high achievers?

One reason that we may be making more progress in math is that there has been more emphasis and publicity on math as a critical filter for girls than there has been around issues of science. The sciences are of many types and many of the models focusing on equity have been in only one science, biology.

This issue needs to be approached from two perspectives: participation (course enrollment in advanced classes) and tested achievement (girls are enrolling in biology and AP biology, but they are not enrolling in physics and advanced chemistry.) Furthermore, girls do not test as well as boys in any of the science areas.

A complicating factor has to do with the construction of the tests themselves. Research by the Educational Testing Service has found that the AP science/math gender gap lessens on essay/open ended questions vs multiple choice items.

Are there specific methods that can be used with high achieving girls? Here again we can only offer suggestions; we do not have hard data. One factor may well be social and peer pressure that does not support girls who excel. For many adolescent girls being smart has social costs and some may deliberately chose not to be "the smartest girl."

Parents may be a critical factor as well, their perceptions of what is important for girls may well focus on the importance of good social skills -- on being popular. This may lead them not to push teachers on academic opportunities in science and math for their daughters, to the same extent they would push for these opportunities for their sons.

5) A number of programs have been established based on the research findings you shared with us today. Do we know which of these programs are the most effective in terms of producing real change? For example, there are one-day programs to expose girls to science, semester-long projects, programs to train teachers, and programs to educate guidance counselors? Which of these options really work?

There is limited evidence on the success of different program/project types over time. One program for which there is data is an intensive four week, two year program with school year follow up sessions that incorporates sport, math/science and personal development stressing individual control, strength and working together. This program, EUREKA at Brooklyn College, is doing an excellent job keeping minority middle school girls from Brooklyn in math and science through high school and beyond.

Patricia Campbell's evaluations of career exposure programs at Smith College and Rutgers University have found that one day career exposure programs do heighten interest in science careers and do produce a reduction in stereotypes about who does science, but there have been no studies to date of whether this heightened interest translates into career participation.

Currently the first major effort to revise preservice teacher training programs and train teachers in gender fair/affirmative math/science/technology methods is being conducted by Jo Sanders at City University of New York sponsored by the National Science Foundation. Followup evaluation procedures will look at the impact on the course syllabi participants use with their students and on the classroom behaviors of the preservice teachers who receive the training.

There is no research evidence that programs to train guidance counselors have had any impact on counselor behavior.

6) You spoke about the necessity of incorporating out-of-school experiences for girls in math and science into classroom situations, since not all girls have the opportunity to participate in such out-of-school activities. What are some possible techniques to accomplish this?

There are in school programs incorporating many of the same techniques found in out-of-school programs but what is often missing in the in-school replications is the affective component of these programs: strong expectations for and encouragement of girls and an environment that is free from harassment (sexual or otherwise) and put downs.

Additional factors that could help include making classroom climate issues a part of teacher evaluation procedures. If teachers aren't rewarded for positive actions or punished for negatives ones, there is very little incentive for them to change.

Creating a structure that rewards teachers financially and publicly for classrooms that create a positive gender fair environment in which girls and boys succeed can create the incentive schools and teachers need.

7) You mentioned in your testimony that the gender gap in math is largest and increasing at the highest achievement levels. Why do you think this is so?

In math it is only at the 8th grade level that this is happening while in science it is occurring at all three levels (4th, 8th and 12th). That the eighth grade is such a critical time reinforces speculation mentioned in response to question 4: girls vulnerability as they enter puberty, their need to fit traditional definitions of a "successful" young woman rather than be labeled as a "nerd."

8) From what we heard at the hearing, the research shows that many of the barriers that women face result from social values and attitudes not only of parents and teachers, but also of peers. What is being done and what else can and should be done to change the stereotypes and attitudes held by males?

Obviously schools alone can not solve these problems, but schools can have an important and positive impact. Boys need to see positive examples of women's accomplishments and skills in their school materials every bit as much as girls do. This should be broader than just including women who have been successful in traditional male roles. We must also include women who have been successful in traditionally female roles. Without positive images of women neither boys nor girls can overcome traditional sex stereotypes that limit options for both women and men.

Furthermore, males of all ages must learn that there are behaviors that will not be tolerated in the school or the work place, and that they risk sanctions and reprisals if they continue harassing, disruptive behaviors.

August 26, 1994

## Hearing: "WOMEN AND K-12 SCIENCE AND MATHEMATICS EDUCATION"

June 28, 1994

## ADDITIONAL QUESTIONS FOR DR. KAHLE

1) What are your views on teaching strategies which emphasize that girls learn more effectively in a cooperative, less competitive environment. Is this a good approach? What is the effect of this strategy on competitive girls and cooperative boys?

1. My study of biology classrooms across the country indicated that two thirds of the girls and boys preferred laboratory and discussion activities to lectures and demonstrations in science classes. Furthermore, the students responded that they enjoyed creative activities such as designing open-ended experiments. More recently, my work (as part of Ohio's statewide systemic initiative) has involved assisting teachers with implementing inquiry activities in science and problem-solving activities in mathematics. In all cases, teachers report that such activities motivate and interest both girls and boys. Although cooperative group learning is advocated as a way to encourage girls, many of whom are socialized to avoid competitive situations, it is not uniformly successful. Teachers must learn to monitor groups for cooperation and to assist students in sharing both tasks and responsibilities in equitable ways. Although competitive girls and boys (who have been successful) are initially frustrated by group work, they flourish once they understand how their work can be extended and elaborated by others in the group. In addition, cooperative groups provide a real-life experience in the way science works; i.e., by laboratory group.

2) You stated in your testimony that girls' interest in math, science, and engineering increased dramatically from 1970 to 1980, but that since 1980, girls' interest has remained constant or even decreased slightly. What is the cause of this decline?

2. During the late 1970s and early 1980s, national, state, and local resources were available for gender equity work. The initial work was a series of programs that directly intervened in the education of girls to encourage them to continue in math, science, and engineering. Because interest was measured by girls' continued participation, we saw national rises in enrollment and in achievement (associated with enrollment in advanced classes). In the mid-1980s funding for such programs diminished drastically, and the programs vanished. Subsequently, enrollments, achievement (related to enrollments), and interest (as expressed on national surveys) declined.

3) With math, where there is a right answer and a wrong answer, it seems straightforward to measure achievement and progress. How is science achievement measured? How are gender differences in math and science achievement interrelated?

3. Actually, in problem-solving mathematics there may be more than one correct answer or way to reach an answer. Evaluation assesses the processes that students use in solving the problem. The same is true in science. Science achievement is best measured by assessing how a student solves a problem or designs an experiment to answer a question. Analyses of the science responses of the International Assessment of Education (IEA) tests and of NAEP science surveys indicate that girls score as well as boys on process questions. They score lower than boys on multiple choice items. One explanation is that significantly more girls than boys choose the "I don't know" response, effectively eliminating the benefit of guessing (20 percent on a test with five-item responses) for girls.

4) The data you presented shows that the situation for girls is improving in math but getting worse in science. Why do you think this is so?

4. There are two basic reasons for the dichotomy between math and science. First, mathematics is commonly viewed as a basic in American education; for example, a public opinion poll in Ohio showed that 97% of adults consider mathematics one of the three most important subjects in school. However, only 31% of Ohio's adults rank science as one of the three most important subjects. Although teachers may be anxious about mathematics, they recognize the need to instruct all pupils in math and considerably more instructional time is spent in mathematics than in science. Second, intervention work began a decade earlier in mathematics. Most importantly, although the programs addressed math anxiety and involved role models and counseling, they also addressed the skills of doing mathematics. Many intervention programs in science (including most that are currently offered) address motivation and interest as well as include role models. However, they do not include training in the skills of doing science (i.e., quantification, observation, transformation of data, estimation of error, control of variables. etc.). This difference has led to a decade of girls with increased interest but not necessarily enhanced skills and, unlike math, has not led to a decrease in the gender gap in achievement in science.

5) A number of programs have been established based on the research findings you have shared with us today. Do we know which of these programs are the most effective in terms of producing real change? For example, there are one-day programs to expose girls to science, semester-long projects,

programs to train teachers, and programs to educate guidance counselors? Which of these options really work?

5. I would like to address effectiveness by educational level with the overall caveat that there is considerable evidence that short-term programs (without continual follow-up) have no lasting effect (regardless of educational level or type of person addressed). The most successful program (University of Northern Colorado) to date for pre-service teachers involves one semester and includes many observations of actual science and mathematics classes and classrooms. Several years after the program the students (now practicing teachers) are using equitable instructional strategies. Shorter, more intensive, programs (approximately one week) may be effective with practicing teachers, if there is sustained support for at least one academic year. I assume that a similar format would be successful with counselors, although I do not know of any models. Most in-school programs involve teachers, not students, for cost-effectiveness; however, their success is measured by changes in student attitudes, interest, and/or enrollments.

Volunteer or out-of-school programs do not always relate to the mathematics and especially to the science taught in school. Particularly in the case of science, out-of-school programs may further marginalize girls' experiences, leading to the belief that science is not something done in school. Although programs of varying length have been effective in providing immediate motivation and attitudinal change, few have proven effective in creating long term changes (i.e., decreasing the gender gap in achievement). One major concern in science is that many out-of-school programs do not build the basic skills of science (which are not nearly as motivational as 'gee whiz' activities).

6) From what we heard at the hearing, the research shows that many of the barriers that women face result from social values and attitudes not only of parents and teachers, but also of peers. What is being done and what else can and should be done to change the stereotypes and attitudes held by males?

6. The best way to address the attitudes and sex-role stereotypes held by males is to enhance the performance of girls in science and mathematics. Only by seeing girls performing and achieving equally with themselves will change occur. One successful approach involves teacher-focused programs that address equity in its broad context; that is, equity in outcomes, resources, and leadership. In those programs, classroom interactions that differ for boys and girls and why they differ are addressed. In addition, societal and educational barriers are discussed. A second approach is to involve parents in equity work and research. Two models for this approach are Jacquelynne Eccles' work at the University of Michigan and the Lawrence Hall of Science programs, Family Math and Family Science.

Both encourage changes in the differential attitudes held by parents that affect the enrollment patterns of their sons and daughters.

In addition, changes are needed in the media. Although it may not be possible to mandate such changes in the private sector, programs that are partially supported by federal funds should be reviewed for possible stereotyping. Equitable treatment, particularly in science programs for young children, could do much to change the sex-role stereotypes and attitudes of both girls and boys.

**Hearing: "WOMEN AND K-12 SCIENCE AND MATHEMATICS EDUCATION"**

**June 28, 1994**

**ADDITIONAL QUESTIONS FOR DR. MALCOM**

**Question 1**

*What do you do to track the students who have participated in your programs to find out whether their involvement had a real impact on their choice of classes or careers?*

Answer

**Tracking the participants of informal science education programs remains a real challenge. Our work with the councils focused on helping them understand the need for and developing capability for local student tracking. Local tracking is likely to be more effective with student participants.**

**AAAS tracked students only for the final year of the 4 year project. Data were collected on attitudes and efforts were not made to determine what students had learned about science. As with other organizations that work with informal education projects, we have found that is very difficult to follow these girls further than the period of the project. Individual participation in programs fluctuates from year to year and tends to decline significantly after 6th grade, and we do not have access to school records.**

**We tracked council activities, particularly sales of badges related to science, throughout the last 3 years of the project and for several months afterwards.**

Science related badge sales soared during the period we were tracking. One council reported a 258% increase in one year.

Since that time while we have not done any formal tracking, we know that the project is being carried on because of continuing orders for materials & patches as well as from information about activities carried in council newsletters.

Question 2

*With out-of-school programs, you can only reach a limited number of students. Are there techniques that have been developed in your programs that could be incorporated within our schools and classrooms?*

Answer

The trainer of trainer models we have utilized have been effective in increasing the number of out-of-school programs using these materials. We have used them in regular teacher professional development programs as well. We have found that teachers as with leaders of out-of-school programs must develop levels of comfort in doing hands on science. Once they understand how effective these are through their own experience they are more likely to incorporate these into their classrooms. They can learn sound gender equity practices which can be applied to both boys and girls and across subject areas.

**We have used the Girls and Science programs to train teachers in Indiana, Virginia, Mississippi, Arkansas, and Nebraska.**

**Question 3**

*The program you discussed is a national one. How are the specific projects and actual locations established? What is the application process? How many applications do you receive; and, of those, what percentage do you fund or accept into your program?*

**Answer**

**A. Dissemination of the program has been through a number of mechanisms:**

- **Word of mouth.**
- **Articles in newspapers and magazines.**
- **General requests for information on our girls in science programming.**
- **Staff presentations at meetings.**

**B. Information is exchanged by phone or letter a complimentary copy of the training manual is sent to the inquiring group. Interested parties usually need to identify a funder. AAAS staff can provide a "boilerplate" proposal. Once all the details are finalized a date is set for the training. Funding is needed for AAAS staff travel, materials, supplies and staff time.**

**Many inquiries are received but only a few are serious. Of those who call or write**

**for a second around of information approximately 50% actually receive the program.**

**The following are some of the places where the project has been (or will be) disseminated.**

| **State** | **Funder** |
|---|---|
| North Dakota (all GS Councils) | Bush |
| South Dakota (all GS Councils)* | Bush |
| Minnesota (all GS Councils) | Bush |
| Indiana (Several Councils) | AAAS |
| Illinois (2 Councils) | Abbott |
| Illinois (Chicago Council) | SLIC (December '94) |
| Wisconsin (1 Council) | Abbott |
| Louisiana (Several Councils) | AAAS |
| North Carolina (1 Council) | Self |
| North Carolina (1 Large Council) | Abbott (August 20 '94) |
| Alaska (1 Council) | Self |
| Pennsylvania (1 Council) | Self |
| New York (1 Council) | SLIC |
| Nebraska (4-H) | USDA grant |
| Iowa | USDA grant |
| Massachusetts (2 Councils) | Local Funder (Spring '94) |

- Black Hills Girl Scout Council in Rapid City does extensive work on local Indian Reservation.

A recently funded NSF grant will deliver a revised version of the program to Girl Scout Councils and other CBO's to two cities in **Texas**, the **Washington DC Metro area**, and **Baltimore, MD** and surrounding Suburbs.

In addition, there are many councils around the country who have implemented the program as a result of sending trainers to workshops held by councils that we have trained. There is no real way to track these but some of which we are aware are Ohio (Several Councils), West Virginia and Delaware.

Girl Scout trainers from ten different states attended a "Wider Ops" event in July of 1993 in Rapid City, SD. They spend 3 days learning activities from both projects as part of their wider ops responsibilities. They carried the programs back to their councils and, since several of them were teachers, implemented it in their schools in varying degrees. Some of the states represented were: **Iowa, Michigan, California, New Jersey, and New York**. The trainer from New York is also a teacher who received money from her principal so she could conduct a training workshop for the teachers in her school. Senior Girl Scouts from South Dakota, who also attended the Wider Ops training have been called on to do the activities with students in various schools around Rapid City and at the Pine Ridge Indian Reservation.

**Department of Energy**
Washington, DC 20585
August 5, 1994

The Honorable Marilyn Lloyd
Chairman
Subcommittee on Energy
Committee on Science, Space, and Technology
U. S. House of Representatives
Washington, DC 20515

Dear Madam Chairman:

On June 28, 1994, Richard E. Stephens, Director, Office of University and Science Education, testified regarding Women and K-12 Science and Mathematics Education.

Enclosed are the answers to the three questions that you submitted to complete the record.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Lillian Owen, on (202) 586-2031.

Very truly yours,

William J. Taylor, III
Assistant Secretary
Congressional and Intergovernmental
Affairs

Enclosure

Printed with soy ink on recycled paper

## QUESTIONS FROM REPRESENTATIVE LLOYD

Question 1: **What do you do to track the students who have participated in your programs--to find out whether their involvement had a real impact on their choice of classes or careers?**

Answer: We have established a number of tracking systems to determine whether or not students involved in our education programs pursue careers in science, mathematics or engineering. For example, our Prefreshman Enrichment Program (PREP) which supports university-based summer enrichment institutes for middle school, women and minority students includes provisions to track the participating students through high school into their choice of a university or college. Our High School Student Honors Research Program which provides opportunities for high school science students to participate in intensive summer research at the Department of Energy National Laboratories also tracks the participating students through their undergraduate and graduate years to their first employment. We are now developing an integrated participant tracking system which will provide information in various levels of detail on all the student participants in the Department's various science education programs. We also have established a comprehensive evaluation approach to understanding whether or not we have made a difference in the ability of teachers who participate in our program to use this experience in their classrooms.

QUESTION FROM REPRESENTATIVE LLOYD

Question 2: Please provide more information about the application and selection process. How many applications do you receive; and, of those, what percentage are you able to fund or accept into your program?

Answer: Each of the Department's science education programs has established application and selection procedures which vary according to the nature and scope of the program. For example, our university-level programs require the students to submit detailed applications with references to the various National Laboratories where they are interested in pursuing summer research. We generally receive approximately 3,000 applications for our summer research programs and are able to support, on average, 900 students. Several of the laboratories, including the Argonne National Laboratory, report that their application to selection ratio is 5:1. Our high school student programs are more structured in terms of the application process. For example, our High School Student Honors Research Program relies on the nomination of participating students from the various states. Each state has a different selection process. Some rely on the results of state science fair competitions to select the participants in the program while others use academic competitions.

## QUESTIONS FROM REPRESENTATIVE LLOYD

Question 3: In your testimony you discuss the Department's museum-based science education program and highlight one project in which a Girl Scout troop in Chicago was able to participate in constructing hands-on museum science exhibits. Can you provide further information about the ways in which young women are involved in the Department's museum-based programs? How can the DOE strengthen this program?

Answer: In addition to funding the successful "SciTech Clubs for Girls" at the Scitech museum in Aurora, Illinois, the Department of Energy's Museum Science Education Program has also supported another museum project which involves young women. This is the Fort Worth Museum of Science "Energy Works" project. This summer 42 seventh grade minority girls have been recruited from economically depressed communities in the Fort Worth area to take part in a 10 week project. The girls are engaged in such science activities as analyzing owl pellets, modeling clay bones, mapping coal bearing earth layers, using computers to study downloaded satellite imagery of geologic features, etc. They will work with magnets, conductors, circuits, and electrical appliances. Blending energy science, geology, and paleontology, the girls in the lab will form a multi-disciplinary approach to the scientific method and the development of problem-solving skills.

The girls will also meet with female graduate students and their geology professors about their personal interests and science careers as well as conducting research on dinosaurs with female paleontologists on an active site.

In the peer review process, strong consideration has been given by the reviewers to programs and exhibits that focus on underrepresented minorities. We will include a statement in the FY 1995 grant solicitation encouraging museums to submit proposals which specifically target girls and other underrepresented minorities. Coordination with the Association of Science and Technology Centers to publish articles and make presentations of these successful projects at the annual conference to their museum peers will also be encouraged.

## Response to Questions following

## Testimony to the U. S. House of Representatives

## Committee on Science, Space, and Technology

## Energy Subcommittee

**Dr. Rebecca Failor**
**Member of Board of Directors and former President**
**Math/Science Network**

June 28, 1994

Question 1:
**What do you do to track the students who have participated in your programs - to find out whether their involvement had a real impact on their choice of classes or careers?**

Response from the Math/Science Network:
Tracking and trending of young women who attend Expanding Your Horizons in Science and Mathematics (EYH) Conferences since 1976, when the program started, has varied with time and location. From 1980 to 1982 an evaluation was performed with young women who attended several EYH Conferences held near San Francisco, California. The Conferences were found to have a profound effect on the young women's mathematics education plans, career aspirations, and self-initiated science and mathematics activities, immediately after the Conference. Later in the year the students who attended EYH Conferences were found to have higher enrollment in non-required mathematics classes than the control groups. A significant increase in self-initiated career-related activities was maintained for the older students who attended EYH conferences.

The evaluation methodologies developed in this study are documented in a book entitled Evaluation Counts: A Guide to Evaluating Math and Science Programs for Women (Barbara Gross Davis and Sheila Humphreys, 1983, publication sponsored by the National Science Foundation (NSF)) that is available to all EYH Conferences nationwide as a resource for local studies to be performed. One such effort is documented in a 1990 study entitled The Effects of a Short-Term Intervention Program on Future Participation in Math and Science, (J. A. Tomhave, Masters Thesis, 1990, University of North Dakota), comparing young women who had registered for a 1980 EYH Conference, one group who had attended the Conference, with a group who could not attend due to a blizzard blocking their access. Her research showed that attending the EYH Conference had a long-term positive influence on the participants. Young women who attended took more advance mathematics and science classes in high school, planned to continue higher education, and rated their attitudes toward mathematics and science more positively than those who did not attend the Conference.

Other local studies use non-verbal evaluation mechanisms, such as drawings of scientists and what scientists do, made before and after the students attend EYH Conferences to examine the effects of the conferences. The differences are dramatic indications that EYH Conferences change the young women's perceptions from one of foreboding, frightful images of science and male scientists, to ones where they are included in the picture and people are being helped. In recent years the Office of Public Instruction in Montana reported that communities where EYH Conferences are held have substantially higher percentages of young women in advanced mathematics courses than do communities without EYH Conferences.

Anecdotal reports are often unsatisfactory from a scientific point-of-view, but must not be discounted in the absence of more firm data. The continued growth of the number of EYH Conferences nationwide, almost doubling in the past six years, shows that communities across the country see the Expanding Your Horizons experience as one that provides an effective intervention strategy for their young women. A recent member of the Math/Science Network Board of Directors is an "alumnae" of EYH Conferences in Salt Lake City in the 1980s, who is now a computer scientist. Many EYH Conferences nationwide report that they have role models working with the young women, describing their careers in science, engineering, or mathematics, who attended EYH Conferences as students in their hometowns. But teachers bring us the majority of our anecdotal reports, telling of a special confidence and excitement the young women have when they return to class from the Conferences. The Math/Science Network recommends that EYH Conferences be held in March just before young women pick their classes for the next year. Teachers and guidance counselors report that EYH attendees ask for more advanced mathematics and science classes than non-EYH attendees.

The Math/Science Network believes that more statistical evaluations, especially longitudinal studies, are required to adequately evaluate the effectiveness of and fine-tune this type of intervention strategy. However, these studies are very costly. As part of a recent proposal we recommended that two questionnaires, six months apart, be sent to 5% of the young women that attend EYH Conferences in 1995, that is approximately 2250 young women sampled twice. Assuming a 10% response rate from each mailing we could generate a sufficient sample to provide good statistics for an evaluation of the impact on the EYH Conferences they attended. We further proposed to make personal contact with 0.5% or about 250 students and include them in a ten year longitudinal study. However, such efforts are costly and we have yet to find a sponsor for such data gathering activities. We would welcome direction on potential sponsors for data gathering proposals.

**Question 2:**
**With out-of-school programs, you can only reach a limited number of students. Are there techniques that have been developed in your programs that could be incorporated within our schools and classrooms?**

There are a number of schools and school districts throughout the country that incorporate the Expanding Your Horizons in Science and Mathematics Conference experience into their school activities. Some hold EYH Conference on a school day as a special program for girls, some have EYH role models attend the classes before the Conference begins so young men can see the women in science careers, too.

Though the basic Expanding Your Horizons Conference is a short term activity, it is well-suited to follow-on activities that nurture the beneficial experience of the Conference. As an example, mentoring programs set up through the schools connect students with the role models from the EYH Conference they attended for continued interaction, encouraging visits to the woman's workplace. Expanding More Horizons was a special project, funded by the Ford Foundation, to combine the traditional Expanding Your Horizons Conference with a mentoring program in Greensboro, North Carolina. Frequently school districts invite EYH role models to the schools after the Conference to provide the hands-on opportunities to male students and those who could not attend the EYH Conference.

The student materials that are developed by the Math/Science Network for distribution at Expanding Your Horizons Conferences are being used in at least 15 school districts around the country to supplement their own educational materials. We encourage this and would like to work collaboratively with other organizations to increase this effort.

**Question 3:**
**The program you discussed is a national one. How are the specific project and actual locations established? What is the application process? How many applications do you receive; and of those, what percentage do you fund or accept into your program?**

The Math/Science Network seeks to establish Expanding Your Horizons Conferences in any community where there is an enthusiastic group of workers who feel that their 6th through 12th grade young women will benefit from a program based on the following goals:

- introduce successful, real women in science and mathematics-based careers as positive role models for young women

- provide fun, hands-on experiences with mathematics, science, engineering, and technology to instill a can-do approach to learning

- encourage continued mathematics and science education, especially at the secondary level

- increase awareness of the importance of science and mathematics in careers and opportunities for women in these careers

- promote science, math, and engineering for students with special needs.

In the 1993-1994 year there were 125 EYH Conferences in 31 states. This represents a steady growth over the past five years, when there were 76 EYH Conferences.

There are three major avenues for expansion of EYH Conferences. The predominant mechanism is word-of-mouth, where Conference volunteers from one area recommend the program to their friends and colleagues in another community. The second mechanism is as a result of the Math/Science Network's continuing national publicity efforts, through articles in educational magazines, speaking at conferences, letters to professional organizations, etc. The American Association of University Women (AAUW) branches represent the third major growth mechanism for EYH Conferences. Through their recent Educational Equity Initiative Call to Action many branches have adopted EYH Conferences as their method to combat the subtle, discouraging messages our young women receive regarding math and science careers and their future.

Each year, new EYH Conference sites register with the Math/Science Network. Since our annual cycle coincides with the school year we distribute approximately 300 start-up packets in August to encourage the sites to register. Start-up packets are distributed to all EYH Conferences that have been held in the past three years and to those who have made inquiries during the year about holding a conference. To register, the sites provide general information about their Conference plans and submit a modest registration fee, $75 for individual sites, less per site for agencies representing groups of sites. In the 1993-1994 year there were 125 EYH Conference sites registered. There were no sites that were not accepted.

The Math/Science Network's funding is not sufficient to provide funding for local EYH Conferences, though we have submitted proposals that would include start-up funding for new sites in disadvantaged communities. We have never turned down a site's request to hold an EYH Conference based upon their inability to pay the registration fee. We do provide guidance to the sites on fundraising mechanisms for their local expenses.

We believe that one of the strengths of the EYH Conference program is the ability for local, grass-roots organizations to tailor the program to the needs and resources of their communities. For this reason, each EYH Conference is unique.

To assure the quality of the EYH Conference experience the Math/Science Network develops and distributes organizational materials to each site to provide them guidance on the expectations for their EYH Conference and to help them avoid common problems. An emphasis in this material is the recruitment of female role models and their presentation. Included are hints on successful hands-on workshops that provide the young women with positive experiences. In addition, the EYH coordinators have access to phone support from the Math/Science Network office to help them in their planning.

Every site is contacted by our office at least once per year to check on their progress and answer questions they may have. New sites receive special attention. They are provided with a copy of the EYH Handbook for Planners and a copy of the summary report from the 1992 National Workshop for EYH Coordinators. This NSF-sponsored meeting was the first time that people responsible for coordinating EYH Conferences could meet to share their ideas, experiences, and enthusiasm. Whenever possible members of the Math/Science Network Board of Directors meets with local EYH Coordinators or attends EYH Conferences to review their program and provide guidance on ways their community can meet the goals of the EYH Conferences.

## Correction to the Transcription of oral testimony provided by Dr. Rebecca Failor, of the Math/Science Network. to the House of Representatives Subcommittee on Energy, Committee on Science, Space, and Technology on June 28, 1994

Please make the following corrections to the transcript of my presentation and questions:
page 69 line 1582 change "coordinators" to "coordinator"
page 69 line 1592 change the number from "40" to "40,000"
page 70 line 1613 change "include" to "includes"
page 72 line 1643 change "willing" to "willingly"
page 72 line 1649 change "lasts" to "last"
page 72 line 1656 change "have" to "has"

Stacy Kass, Girls, Incorporated

**Hearing: "Women and K-12 Science and Mathematics Education"**
**Girls Incorporated Response to Additional Questions**
**July 28, 1994**

1) **What do you do to track the students who have participated in your programs to find out whether their involvement had a real impact on their choice of classes or careers?**

As a national organization Girls Incorporated does not track individuals who participate in programs in their local communities. However, individual Girls Incorporated affiliates that implement Operation SMART use several evaluation tools developed by Girls Incorporated to measure the effectiveness of their programs which include *Assess for Success Needs Assessment and Evaluation Guide* and the *Operation SMART Research Tool Kit* -- a set of program and evaluation activities in which girls assess their attitudes about science, math and technology.

2) **With out-of-school programs, you can only reach a limited number of students. Are there techniques that have been developed in your programs that could be incorporated within our schools and classrooms?**

The activities and techniques that are used in Girls Incorporated Operation SMART programs could be incorporated within schools and classrooms. Many schools have purchased Operation SMART curricula and have requested training from our national organization. At the local level, a great number of Girls Incorporated affiliates collaborate with their community's schools. This includes using Girls Incorporated staff to implement Operation SMART programs during the school day and conducting training on equitable, hands-on math and science education for regular classroom teachers.

3) **The program you discussed is a national one. How are the specific projects and actual locations established? What is the application process? How many applications do you receive; and, of those, what percentage do you fund or accept into your program?**

Girls Incorporated is a national youth service, program development, training, research and advocacy organization. Our nationally developed model programs, including Operation SMART, are offered through a network of 135 autonomous affiliates that conduct programs in 750 sites across the country. The Girls Incorporated training department offers comprehensive training to youth development professionals who are interested in conducting Operation SMART programs. The national organization does not establish specific Operation SMART program locations nor does it have an application process for doing so.

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

September 2, 1994

OFFICE OF THE
ASSISTANT DIRECTOR
FOR EDUCATION AND
HUMAN RESOURCES

Honorable Marilyn Lloyd
Chairman
Subcommittee on Energy
U.S. House of Representatives
Committee on Science, Space, and Technology
Rayburn House Office Building, Suite 2320
Washington, DC 20515-6301

Dean Madam Chair:

Thank you for giving me the opportunity to testify at your hearing on June 28, 1994 regarding "Women and K-12 Science and Mathematics Education."

Enclosed are the responses to the questions you attached to your letter of July 25, 1994. In addition, I am returning the marked up copy of my testimony.

Sincerely,

Jane Stutsman

Jane T. Stutsman
Deputy Assistant Director

Enclosure (2)

Telephone (703) 306-1600 FAX (703) 306-0399

## Hearing: "WOMEN AND K-12 SCIENCE AND MATHEMATICS EDUCATION"

## JUNE 28, 1994

## ADDITIONAL QUESTIONS FOR DR. STUTSMAN

1) **QUESTION: What do you do to track the students who have participated in your programs - to find out whether their involvement had a real impact on their choice of classes or careers?**

ANSWER: Each Model Project and Experimental Project is required to submit an appropriate evaluation plan for its target population. Evaluation may measure change in participants' attitude toward science, engineering, and/or mathematics; change in course selection following a particular activity; retention in a science, engineering, or mathematics college major; or change in choice of major. In addition, NSF program staff, with technical assistance from the NSF Division of Research, Evaluation, and Dissemination, (RED) will be developing a plan to monitor the program as a whole. This monitoring plan will collect data on program characteristics and events on a continuing basis, to be informed about the extent to which program goals and management objectives are being met.

2) **QUESTION: From what we have heard today, the research shows that many of the barriers that women face result from social values and attitudes of peers. How do your programs address this side of the issue? We have heard about programs that target women, but what is being done to change the stereotypes and attitudes held by males?**

ANSWER: The Experimental Projects for Women and Girls intend to impact the climates in which girls and women learn science, engineering, and/or mathematics. These projects must show evidence that systems or institutions will be changed, not just the individual females moving through the system during a given period of time. Examples of projects funded during this first year include:

United Connecticut Women in Science, Engineering, and Mathematics (Principal Investigator (P.I.) Dr. Carmen Cid,). This project is directed toward making permanent changes in women's and girls' access to, and participation and achievement in science, engineering, and mathematics, especially among economically disadvantaged and underrepresented minority populations. It will develop and implement systemic change strategies reaching parents, teachers and professors, guidance counselors and other school administrators, school board members, community leaders, and students. It will build on existing resource and advocacy efforts by professional organizations, stakeholder groups, state and local education agencies, and institutions of higher education.

The Preparation of Gender-Sensitive Science Teachers in the University of Delaware's Secondary Science Education Program (Dr. Kathryn Scantlebury, P.I.). This project will study the impact of gender equity training on the teaching practices of preservice and inservice teachers in secondary-level science. Both groups will participate in summer workshops, course work, seminars, and meetings which will have gender equity in sciences as a central theme.

3) QUESTION: **With out-of-school programs, you can only reach a limited number of students. Are there techniques that have been developed in your programs that could be incorporated within our schools and classrooms?**

ANSWER: Projects funded by the programs for Women and Girls include both in-school and out-of-school activities. Those which are out-of-school reach girls and women, as well as the teachers, parents, and community members who influence their career decisions. Some of the techniques developed in out-of-school programs have been incorporated into schools and classrooms and vice-versa. For example techniques developed in science camps or science centers are shared with elementary school teachers to enhance the resources available for in-class activities. To further broaden the impact of these projects, NSF requires that each of them develop a dissemination plan as an integral part of the funded project.

4) QUESTION: **Research shows that in order to increase girls' participation in math, science, and engineering, it is important not only to change the attitudes of the girls, but also to convince the parents and teachers that these are acceptable careers for their daughters and female students. How do your programs address this issue?**

ANSWER: Many of the projects funded by the programs for Women and Girls include parents, teachers, staff of community organizations, and others who influence the career decisions of females. Because we are aware that young women are often more strongly influenced than young men by the opinions of family, teachers, and friends, these groups must be included in any effort to increase the participation of females in science, engineering, and mathematics careers and activities. The Information Dissemination program activities address multiple audiences through printed materials, videos, workshops and conferences by specifically highlighting women who have chosen science and engineering as careers. Discussions focus on the full range of opportunities possible in pursuing science and engineering careers and how to prepare for them, as well as examining the reasons that have traditionally influenced young women to decide on careers in non-science fields.

5) QUESTION: **The programs you discussed are national. How are the specific projects and actual locations established? What is the application process? How many applications do you receive; and, of those, what percentage do you fund or accept into your program?**

ANSWER: The specific projects and actual locations of projects are established through our aggressive dissemination of information about the funding opportunities and a multi-disciplinary competitive review process. Program announcements soliciting proposals are mailed to a broad audience of potential proposers. Information about the programs has been published in scientific, technical, and educational journals. The program directors have spoken at numerous national and regional meeting.

Once proposals are received, they are evaluated through a merit review system. Reviewers are selected who have a broad understanding of gender equity or who have expertise in a particular setting (science museum, elementary school, community organization, etc.). Recommendations from the reviewers are taken into consideration along with other factors such as geographic location, setting in which the sponsored activities will occur, and attention to populations underrepresented based on socioeconomic status, racial or ethnic group, etc.

The following awards have been made in FY 1992-1994.

- In 1992, 20 gender-focused proposals were received for the Career Access Program; 11 awards were made.
- In 1993, Model Projects for Women and Girls received 62 proposals and 16 awards were made.
- In 1994, Experimental Projects for Women and Girls received 187 preliminary proposals, 61 formal proposals, and 11 have been recommended for funding.
- In 1994, Model Projects for Women and Girls received 55 proposals and 17 of them have been recommended for funding.
- In 1994, 10 preliminary proposals were received for Information Dissemination Activities, 2 formal proposals were received and both of them have been recommended for funding.
- Another 2 projects were funded in 1994 as "Special Projects", as they did not easily fit any of the categories of formal programs.

DOE/ET-0006T
(DE94001295)

U.S. DEPARTMENT OF ENERGY

# EDUCATION PROGRAMS CATALOG

1994

> *"Education is the foundation on which our future prosperity as a Nation and people will be based. The Department of Energy is committed to ensuring that our young people receive the best education possible in the particularly critical fields of mathematics, science, and technology. Department of Energy programs in mathematics and science education range across all educational levels with special emphasis placed on helping women and minority students become full partners in the Nation's scientific and technical enterprise."*
>
> Secretary of Energy Hazel O'Leary

# PREFACE

Since its formation in 1977, the U.S. Department of Energy (DOE) has been authorized to support education programs that help ensure an adequate supply of scientists, engineers, and technicians for energy-related research, production activities, and the transfer of technology. New emphasis and a broader focus have been given to this responsibility in recent years.

Building on its tradition of support for science and mathematics education, the Department of Energy convened a national conference in 1989 in Berkeley, California, to chart the course of its current and future educational mission. The conference produced a blueprint for action for the agency. What emerged from that conference was a clear vision of the important role that DOE, its facilities, and its 169,000 Federal and contract employees can play in the educational life of their communities, and, as unique scientific resources, in the educational life of the Nation.

Many of the programs listed herein are the result of this new vision; others have existed for many years. The purpose of this catalog is to make all Departmental education efforts more widely known so that more teachers, students, and others can benefit from these unique opportunities.

Supporting the hundreds of education programs in this catalog is the network of DOE national laboratories, technology centers, and other research facilities. Brief descriptions of each facility, its programs, and contact information for its education personnel are included.

Nick Sutphen and Jennifer Pritchard explain the process of plant growth in the grow lab to Secretary of Energy Hazel O'Leary on her visit to the Central School of Somerville, New Jersey.

| NATIONAL PRECOLLEGE PROGRAMS | PAGE NUMBER | TARGET AUDIENCE Student | Teacher/Faculty | Other |
|---|---|---|---|---|
| Council of Energy Resource Tribes (CERT) Student Internships and Fellowships | 9 | x | | |
| Earth Day Poster Contest | 10 | x | | |
| Global Climate Change Curriculum | 10 | x | | |
| Hands-On Universe | 10 | x | | |
| High School Science Student Honors Program | 11 | x | | |
| High School Student Research Apprenticeship Program | 12 | x | | |
| International Science and Engineering Fair Special Awards | 12 | x | | |
| Mathematics Education Initiatives | 13 | x | | |
| National Education Supercomputer Program (NESP) | 13 | x | | |
| National Science Bowl | 14 | x | | |
| ProFreshman Enrichment Program (PREP) | 17 | x | | |
| Preservice Teacher Enhancement Program (PRETEP) | 17 | x | | |
| Young Scholars Alert Program | 18 | x | | |
| FCCSET Federal Laboratory Teacher Training Program | 10 | | x | |
| Hands-On Universe | 10 | | x | |
| LESSON (Lawrence Livermore National Laboratory Elementary School Science Study of Nature) | 12 | | x | |
| National Geographic KidsNetwork | 14 | | x | |
| National Teachers Institute in Materials Science and Technology | 15 | | x | |
| New Explorers Partners | 16 | | x | |
| Students Watching Over Our Planet Earth (SWOOPE) | 17 | | x | |
| Teacher Institutes in Fossil Energy | 18 | | x | |
| Teacher Research Associates (TRAC) Program | 18 | | x | |
| Instructional Materials Development and Distribution | 12 | | | x |
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Figure 1 Quick Reference for National Programs: Target Audiences

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# INTRODUCTION

## The Department of Energy's Mission and Structure

The U.S. Department of Energy (DOE) was created in 1977 to consolidate into one Cabinet-level department the responsibilities previously carried out under the Atomic Energy Commission, the Energy Research and Development Administration, the Federal Energy Administration, several smaller energy-related agencies, and offices in other Federal departments.

Missions assigned to DOE by Congress include fundamental scientific research, research and development of energy technologies, energy conservation, strategic weapons development and production, energy regulation, energy data collection and analysis, federal power marketing, and education in science and technology. To fulfill these functions, DOE and its contractors employ approximately 169,000 men and women, 80,000 of whom are scientists, engineers, or technicians.

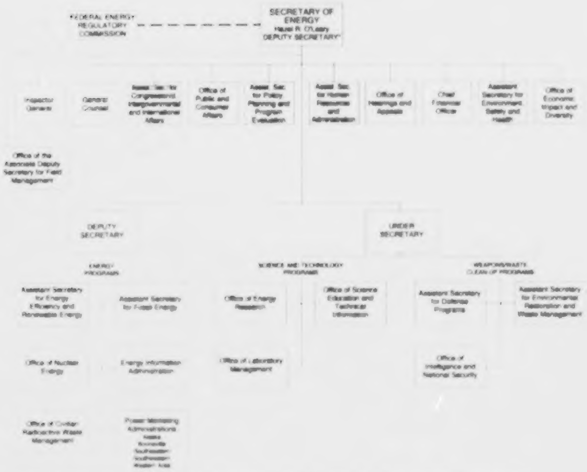
Within DOE, program offices administer the majority of DOE's research, development, and/or programs. These include Science Education and Technical Information; Energy Research; Civilian Radioactive Waste Management; Environmental Restoration and Waste Management; Fossil Energy; Nuclear Energy; Energy Efficiency and Renewable Energy; Defense Programs; Environment, Safety and Health; and Economic Impact and Diversity. The remaining offices discharge Department-wide support functions, such as policy analysis, financial and legal management, personnel administration, and public affairs. Figure 2 identifies major program areas within the Department.

In addition to its headquarters components, the Department of Energy has an extensive field structure of world-class laboratories, research facilities, regional field support offices, and regional power administrations. These facilities are dispersed widely across urban and rural areas of the country.

Directly contributing to DOE's mathematics and science education initiatives are 10 DOE national laboratories and more than 30 specialized research facilities. Exciting research in contemporary science is conducted at the facilities. The Synchrotron Light Source at Brookhaven National Laboratory, the Intense Pulsed Neutron Source at Argonne National Laboratory, lasers, electron microscopes, advanced robotics, and supercomputers are examples of some of the unique tools that DOE employs in exploring research frontiers. Nobel laureates and other eminent scientists employed by DOE laboratories have

Young visitors at SciTech in Aurora, Illinois, learn through their own experiences with displays built by Girl Scouts.

accomplished landmark work in physics, chemistry, biology, materials science, and other disciplines. The Department oversees an unparalleled collection of scientific and technical facilities and equipment with extraordinary potential for kindling in students and the general public a sense of excitement about science and for increasing public science literacy. Programs funded by DOE and its contractors annually reach more than 1 million students, educators, and members of the public.


FEDERAL ENERGY REGULATORY COMMISSION
SECRETARY OF ENERGY
Hazel R. O'Leary
DEPUTY SECRETARY*
Inspector General
General Counsel
Assist. Sec. for Congressional, Intergovernmental and International Affairs
Office of Public and Consumer Affairs
Assist. Sec. for Policy Planning and Program Evaluation
Assist. Sec. for Human Resources and Administration
Office of Hearings and Appeals
Chief Financial Officer
Assistant Secretary for Environment, Safety and Health
Office of Economic Impact and Diversity
Office of the Associate Deputy Secretary for Field Management
DEPUTY SECRETARY
UNDER SECRETARY
ENERGY PROGRAMS
SCIENCE AND TECHNOLOGY PROGRAMS
WEAPONS/WASTE CLEAN-UP PROGRAMS
Assistant Secretary for Energy Efficiency and Renewable Energy
Assistant Secretary for Fossil Energy
Office of Energy Research
Office of Science Education and Technical Information
Assistant Secretary for Defense Programs
Assistant Secretary for Environmental Restoration and Waste Management
Office of Nuclear Energy
Energy Information Administration
Office of Laboratory Management
Office of Intelligence and National Security
Office of Civilian Radioactive Waste Management
Power Marketing Administrations
Alaska
Bonneville
Southeastern
Southwestern
Western Area

* Deputy Secretary oversees Energy Programs and serves as Chief Operating Officer of the Department within the Office of the Secretary

Figure 2. Department of Energy

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## The Department of Energy's Education Mission

With such a diversity and magnitude of scientific and technical involvement, DOE is both an employer and a patron of the Nation's scientific and engineering talent. The U.S. Department of Energy requires a steady flow of well-educated, highly skilled, scientific and technical personnel to carry out its basic research and development and its operational missions. In recognition of this need, education has been an essential part of the Department's mission since its creation, just as it was under its predecessor agencies. In the President's FY 1994 budget request for the Department of Energy, $128.8 million was earmarked for mathematics, science, and engineering education programs. At the precollege level, the FY 1994 request is $45.4 million (Figure 3).

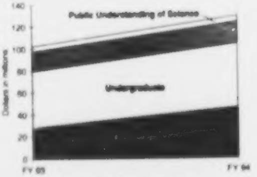

Figure 3. DOE Education Funding
FY 1983–1994

Until 1990, DOE's educational emphasis was primarily focused on university level education, with the agency providing graduate student fellowships and research appointments at DOE facilities. More recently, the education mission was expanded to include precollege education and science literacy. The 1977 DOE Reorganization Act authorizes education and training activities necessary to ensure that the Nation has an adequate technical work force in energy-related research and production fields. These fields include mathematics, physics, geology, chemistry, zoology, biology, and other areas of basic and applied research. The Department of Energy Science Education Enhancement Act (part of the 1991 National Defense Authorization Act) expands the Department's authorization to support science education at all levels, including public understanding of science, and amends the 1977 legislation to make support for science education a major mission of the Department.

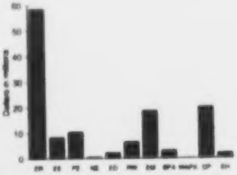

Figure 4. DOE Education Funding by Program Office—
FY 1994 Request

In 1993, the Office of Science Education and Technical Information was created to coordinate the Department's science education activities and to directly support a variety of science and engineering education programs from the precollege to the postgraduate levels. Other DOE program offices are also deeply involved in supporting education activities related to their own program functions and needs (Figure 4). For example, the Office of Environmental Restoration and Waste Management encourages young people to consider careers in environmental remediation, enhances the skills of teachers, and improves public awareness of environmental and waste-management issues. The Office of Fossil Energy reaches out to elementary school students with information on coal, oil, and the use of fossil fuels. The Office of Energy Efficiency and Renewable Energy sponsors the annual collegiate SunRayce and other vehicle competitions to promote energy-conservation awareness in schools.

As noted, DOE provides substantial support for science education through its field offices, national laboratories, technology centers, and other research facilities, each conducting a range of coordinated and complementary education programs and making resources available to precollege and university faculty and students. Each facility plans and administers a range of precollege and university science-education programs, which vary according to laboratory specializations and local needs, and which place special emphasis on providing hands-on experiences to students and teachers.

## In Support of the National Education Goals

Geri Anderson-Nielsen, a mathematics coordinator and teacher on leave from Edmund Burke School in the District of Columbia where she was a Presidential Awardee for Excellence in Science and Mathematics Teaching. She was also an Albert Einstein Congressional Fellow on the staff of the Senate Labor and Human Resources Committee. DOE helps support these congressional fellowships.

The Department of Energy's education efforts support the National Education Goals (Figure 5). DOE is placing increasing emphasis on its precollege education efforts. The Secretary of Energy began by convening the Math/Science Education Action Conference in October 1989. This assembly of more than 200 government, education, science, and business leaders was held in Berkeley, California. The conference report, published in May 1990, outlined the Departmental strategy for precollege science education. It presented a set of public–private initiatives to be undertaken by the Department and its facilities in partnership with other Federal agencies, States, schools, businesses, industries, and community groups.

The strategy is based on five premises:

- Serious efforts to produce students with excellent mathematics and science skills must begin at the elementary school level and reach all students.
- Science and mathematics teachers must become full partners in the scientific community.
- Programs must encourage full participation by women and minorities, groups currently underrepresented in mathematics and science fields.
- DOE must use more fully its unique, regional scientific facilities and staff to improve mathematics and science education.
- DOE's efforts must be integrated with those of other Federal agencies, the States and territories, and the private sector to yield the greatest benefit for the Nation.

At the heart of the strategy are specific education initiatives that DOE and its national laboratories and research facilities are undertaking in partnership with others. These initiatives include formal agreements with other Federal agencies; teacher-training activities that use DOE facilities; programs for groups of students underrepresented in science and technology; and volunteer and community programs involving DOE scientists, engineers, and technicians.

In pursuing this strategy, DOE's efforts will be carefully linked with the efforts of other Federal agencies through the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). As summarized in Figures 6a and 6b, the actions that DOE is taking to enhance science and mathematics education are being coordinated through the FCCSET Committee on Education and Human Resources. The Committee has adopted a series of strategic objectives and implementation priorities to improve science and mathematics education in the United States. These priorities are summarized in the report "Pathways to Excellence—A Federal Strategy for Science, Mathematics, Engineering, and Technology Education" (see the Other DOE Related Materials information section, page 148).

This catalog provides specific information about DOE education programs. Examples of some precollege and university level programs are given in the next sections. *Not all programs are described, but the breadth and flavor of activities are demonstrated.* Following the Program Descriptions section, a list of DOE program offices is provided with the appropriate contacts for information on education programs.

Jason Bullock, Secretary of Energy Hazel O'Leary, and Kristen Schuman are examining a specimen under the zoom microscope at the Central School in Somerville, New Jersey.

### National Education Goals

**By the Year 2000:**

1 All the children in America will start school ready to learn.

2 The high school graduation rate will increase to at least 90 percent.

*3 American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter, including English, mathematics, science, history, and geography, and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.

*4 U.S. students will be first in the world in science and mathematics achievement.

5 Every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.

6 Every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning.

*Goals which specifically address achievement, competency, and literacy in science and mathematics education.

Figure 5. National Education Goals

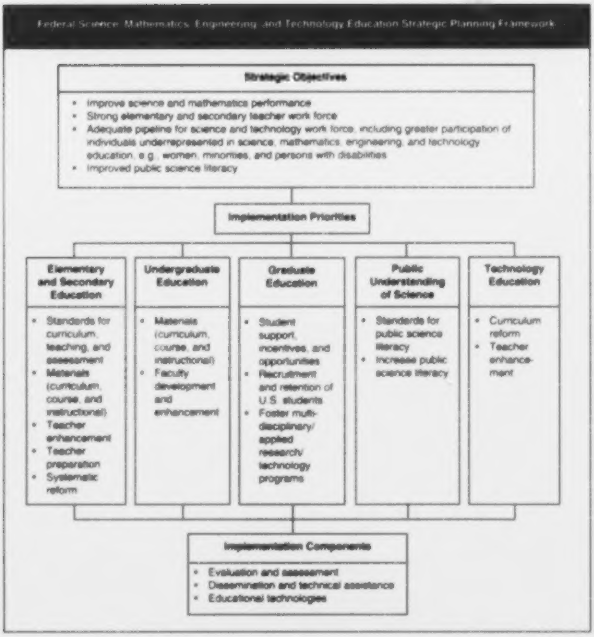
Federal Science, Mathematics, Engineering, and Technology Education Strategic Planning Framework
Strategic Objectives
• Improve science and mathematics performance
• Strong elementary and secondary teacher work force
• Adequate pipeline for science and technology work force, including greater participation of individuals underrepresented in science, mathematics, engineering, and technology education, e.g., women, minorities, and persons with disabilities
• Improved public science literacy
Implementation Priorities
Elementary and Secondary Education
• Standards for curriculum, teaching, and assessment
• Materials (curriculum, course, and instructional)
• Teacher enhancement
• Teacher preparation
• Systematic reform
Undergraduate Education
• Materials (curriculum, course, and instructional)
• Faculty development and enhancement
Graduate Education
• Student support, incentives, and opportunities
• Recruitment and retention of U.S. students
• Foster multi-disciplinary/applied research/technology programs
Public Understanding of Science
• Standards for public science literacy
• Increase public science literacy
Technology Education
• Curriculum reform
• Teacher enhancement
Implementation Components
• Evaluation and assessment
• Dissemination and technical assistance
• Educational technologies

Figure 6a

### FY 1993 Federal Science, Mathematics, Engineering, and Technology Education Priority Framework

**Base Program**

- Maintain and capitalize on current world-class programs (e.g., graduate education, student incentives and opportunities, education technology . . . ) and opportunities for groups underrepresented in mathematics and science (e.g., women, minorities, and persons with disabilities)

**Tier I Priorities: Reforming the Formal Education System**

**Elementary and Secondary Systemic Reform**

- Curriculum, teaching, and assessment standards: development and implementation
- State curriculum framework: development and implementation
- Curriculum course and instructional materials: development and implementation
- Teacher enhancement and preparation

**Undergraduate: Revitalization**

- Curriculum, course, and instructional materials: development and implementation (lower division)
- Undergraduate faculty enhancement

**All Education Levels: Evaluation**

- Evaluation of Federal agency programs

**Tier II Priorities: Expanding Participation and Access**

- Increase participation of groups underrepresented in science, mathematics, engineering, and technology: all education levels
- Identify, disseminate, and promote adoption of exemplary program strategies and materials: all education levels
- Identify Federal strategies to employ educational technologies more broadly

**Tier III Priorities: Enabling Activities**

- Increase public understanding of science
- Promote formation and strengthening of partnerships between two-year institutions and other sectors

Figure 6b

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Nick Sutphen and Jennifer Pritchard explain the process of plant growth in the grow lab at the Central School in Somerville, New Jersey, to Secretary of Energy Hazel O'Leary.

As part of the DOE-funded Science Careers Ladder Program, Jorge Delacruz and Estevan Otro, interpreters at the New York Hall of Science taking part in the program, dissect the eye of a cow and discuss its parts and function with visiting students.

A student on a field trip to the New York Hall of Science uses a microscope to discover science.

# PROGRAM DESCRIPTIONS

For more than 40 years, DOE and its predecessor agencies have supported programs that enhance the science, mathematics, engineering, and technology programs offered by academic institutions. These programs make effective use of the resources of DOE's system to provide educational experiences not otherwise available to students and faculty. Scholarship, fellowship, and other programs are designed to provide direct support to students on campus. Some programs are national in scope; some are regional or local. Still others are designed to improve the public understanding of science. Brief descriptions of some of the over 800 national DOE programs and DOE facilities' programs are described in this catalog. The programs described are not inclusive of all DOE laboratory and facility education programs. For the most current information regarding the status and eligibility for these and new DOE education programs, contact the educational program contacts at the laboratories, facilities, and offices identified in this catalog.

## Precollege Programs

Precollege programs developed by DOE and made available to the education community are designed to achieve these objectives:

- To better prepare new teachers and to enhance the knowledge and teaching ability of experienced ones
- To encourage long-term reform of the Nation's science education system
- To foster research and development in teaching methods and materials
- To promote dissemination of new techniques and media
- To provide technical assistance to educators
- To optimize organizational reform and the operation of educational systems
- To offer support, incentives, and opportunities to students

Some of these programs are conducted at the national level, while others are at the local or regional level.

### NATIONAL

**Council of Energy Resource Tribes (CERT) Student Internships and Fellowships**—The Department of Energy, together with its National Renewable Energy Laboratory (NREL) and the Western Area Power Administration (WAPA), provides research opportunities for Native American college students. CERT, in turn, provides NREL researchers training on tribal affairs relating to energy on the reservations and a basic understanding of the culture. For more information contact Gail Pritchard, (202) 586-1177.

Manuel Steele, a San Carlos Apache and a participant in the Council of Energy Resource Tribes (CERT) program, is studying renewable-energy technologies under the tutelage of his mentor, Tom Potter, from the National Renewable Energy Laboratory.

This poster invites participation of elementary school students in contest sponsored by DOE and the National Association of Elementary School Principals to commemorate Earth Day

Jeff Hale, a science teacher from Arroyo Seco Elementary School in Livermore, California, tries out a hands-on experiment that he developed for the K–5 Global Climate Change Curriculum developed at Lawrence Livermore National Laboratory

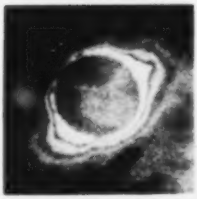
**Earth Day Poster Contest**—Since 1990, DOE has commemorated Earth Day by holding a nationwide annual poster contest for elementary school students. DOE collaborates with its longtime educational partner the National Association of Elementary School Principals (NAESP) to expand school participation. For the contest, a theme linking environmentalism with energy technologies is chosen. Participating DOE facilities send their representative student poster to be displayed at DOE Headquarters in Washington for a period of time commemorating Earth Day. Prizes, which are determined annually, are awarded to the top 12 students. For more information contact Gail Pritchard, (202) 586-1177.

**Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) Federal Laboratory Teacher Training Program**—The FCCSET Federal Laboratory Teacher Training Program's 4-week summer institutes expose teachers to cutting edge science in specific content areas and show them how to incorporate what they have learned into the classroom. Approximately 800 teachers receive this intensive training at laboratories and facilities around the country. Participating agencies include the Department of Energy (DOE), Smithsonian Institution, National Aeronautics and Space Administration (NASA), Environmental Protection Agency (EPA), Department of Commerce, Department of Agriculture (USDA), and Department of the Interior (USDOI). Some of the specific facilities hosting the programs are Argonne National Laboratory, Continuous Electron Beam Accelerator Facility, Pacific Northwest Laboratory, Super Collider Laboratory, the Smithsonian Institution's National Museum of Natural History, NASA's Marshall Space Flight Center in Alabama, NASA's Jet Propulsion Laboratory in California, EPA's Andrew W. Breidenbach Environmental Research Center in Ohio, and the National Wetlands Research Center in Louisiana. Topics of the programs include materials science, physics, environmental science, space, the oceans, Earth, and agricultural science. For more information contact Cindy Musick, (202) 586-0987.

**Global Climate Change Curriculum**—Lawrence Livermore National Laboratory supports teachers to work with laboratory scientists to develop multimedia exercises that provide science teachers with instructional materials addressing issues related to the problem of carbon dioxide buildup in Earth's atmosphere. Although the primary focus is on relevant scientific issues, the interdisciplinary nature of the problem is highlighted. A series of 2-week workshops is held for teachers who wish to use the Global Climate Change Curriculum materials in their classes. For more information contact Eileen Vergino, (510) 424-0567.

**Hands-On Universe**—Originally targeting high school teachers and students, this Lawrence Berkeley Laboratory (LBL) program has expanded into the arena of the public understanding of science through partnerships with several science technology centers. Hands-On Universe makes cutting-edge astrophysics research tools and technologies available to a wide audience. Through microcomputers and electronic networks, participants can request astronomical images from the LBL professional-grade telescopes. The microcomputers and communication networks also link participants and professionals in genuinely collaborative apprenticeships. In addition, work is under way to develop astronomy-based science curriculum units for use in the high school classroom, user-friendly image-processing software, astrophysics museum exhibits, and planetarium programs. The National Science Foundation has also provided funding for this program. For more information contact Carl Pennypacker, (510) 486-7429.

**High School Science Student Honors Program**—This national program brings the very best high school science and mathematics students to DOE laboratories for 2 weeks in the summer. Participating students, most of whom are already committed to scientific careers, are given an opportunity to perform energy-related research under the guidance of DOE laboratory scientists. At the end of the program, they present their research findings to other participants. Students from the 50 States, the District of Columbia, Puerto Rico, American Samoa, and several foreign countries attend. In response to an invitation from the Secretary of Energy, governors select participants from their States. Each summer more than 360 students are supported, approximately 40% of whom are women or minorities. Argonne National Laboratory, Brookhaven National Laboratory, Fermi National Accelerator Laboratory, Lawrence Berkeley Laboratory, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, and Sandia National Laboratories/New Mexico participate in this program. For more information contact John Ortman, (202) 586-1634.



This black and white photograph represents a digitized image of the total eclipse on July 11, 1991, taken by TRAC participant Curtis Craig, a high school teacher from American Fork, Utah. A color image was used for the cover of the "U.S. Department of Energy Education Programs Catalog 1992."

Alexander Rice of William Floyd High School in Suffolk County, New York, was one of 60 students to spend 2 weeks doing research at Brookhaven National Laboratory's National Synchrotron Light Source as part of the DOE High School Science Student Honors Program.

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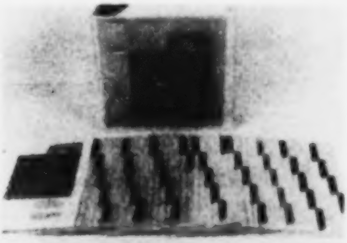
**High School Student Research Apprenticeship Program**—This program is designed to motivate freshman and sophomore high school minority and female students to pursue science careers. About 130 students, of whom more than 80% are minorities or women, come to a laboratory for several days to many weeks during the summer. There they perform laboratory research, attend lectures and seminars, and participate in field activities. Argonne National Laboratory, Brookhaven National Laboratory, Fermi National Accelerator Laboratory, and Pacific Northwest Laboratory are involved in the program. For more information contact Marge Dwyer, (202) 586-8951.

**Instructional Materials Development and Distribution**—Through many of its programs, DOE and its facilities produce educational materials designed for use by teachers and students. Topics include global climate change, acid rain, renewable energy, the harnessed atom, nuclear energy, environmental preservation, electricity, magnetism, superconductivity, fusion energy, power in space, radiation, and a variety of other topics of interest to students at various grade levels.

DOE's Office of Scientific and Technical Information (OSTI), P.O. Box 62, Oak Ridge, TN, 37831, (615) 576-8401, distributes this "U.S. Department of Energy Education Programs Catalog" and additional educational material to the general public and to the education community. OSTI also distributes posters, stickers, consumer guides, student and teacher booklets, flyers, brochures, and other educational materials. Some popular titles include "The First Reactor," "Tips for Energy Savers," and "Science Activities in Energy." Each year, new educational materials are developed and added. All are designed to allow educators to use current energy-related issues to teach basic science and mathematics concepts.

**International Science and Engineering Fair Special Awards**—This program identifies outstanding energy-related science projects at the annual International Science and Engineering Fair. The winning students and their teachers spend 5 days at a DOE laboratory conducting hands-on research, meeting DOE scientists, and touring laboratory research facilities. For more information contact John Ortman, (202) 586-1634.

**Lawrence Livermore National Laboratory Elementary School Science Study of Nature (LESSON)**—LESSON evolved in 1969 from two concerns on the part of scientists at Lawrence Livermore National Laboratory: many local students were not receiving enough instruction in science and many teachers avoided teaching science because they lacked confidence in their knowledge and ability to conduct the instruction. LESSON provides a response to both concerns by instructing teachers in grades K–8 in basic science to help them develop their science knowledge and increase their confidence. Each teacher completing the 60-hour LESSON workshop receives instruction from laboratory scientists; science experiment materials used in the workshop; and a teacher's guide containing descriptions of science concepts, student worksheets, and experiments that can be completed at home or in the classroom in physics, electromagnetism, chemistry, and biology. Each year more than 100 teachers complete workshops at locations throughout the United States, including DOE laboratories and facilities. For more information contact Eileen Vergino, (510) 424-0567.



Lawrence Livermore National Laboratory Elementary School Science Study of Nature (LESSON) workshops are conducted for teachers nationwide by the laboratory's education staff.

**Mathematics Education Initiatives**—Some DOE national laboratories are supporting summer programs for mathematics students and teachers so they can learn new concepts and techniques in mathematics instruction. An example is the National Education Supercomputer Program at Lawrence Livermore National Laboratory. These initiatives are coordinated with the National Academy of Sciences' Mathematical Sciences Education Board (MSEB). For more information contact Cindy Musick, (202) 586-0987.

**National Education Supercomputer Program (NESP)**—A Cray-donated X-MP at Lawrence Livermore National Laboratory (LLNL) has been dedicated for the use of precollege teachers and students from junior high through community college. The goal is to bring the knowledge and expertise of DOE's world-renowned scientists into classrooms to stimulate student interest in advanced studies in mathematics and science. Students and teachers have access to research models on global climate change, three-dimensional geometry and spatial relationships, chemical modeling, structural engineering modeling, earthquakes, and plant physiology. A series of teacher training workshops is conducted regularly on how to access and use the supercomputer. The computer will provide a means of connecting students, teachers, and school systems to a powerful educational and research experience. The DOE High School Science Student Honors Program in Supercomputing (Superkids) brings high school students to LLNL for 2 weeks each summer. For more information contact Cindy Musick, (202) 586-0987.

Participants in the DOE National Education Supercomputer Program (NESP) take a break for a class photo at Lawrence Livermore National Laboratory.

**National Geographic KidsNetwork**—This innovative telecommunications-based science and geography elementary curriculum offers hands-on experience in scientific methods; expands cultural and social awareness; teaches computer technology; and through telecommunications, enables students to share data and information on an international basis. To expand the benefits of the KidsNetwork, the National Geographic Society and DOE entered into a partnership to offer training workshops in the use of the KidsNetwork to elementary school teachers. Scientists at DOE facilities are involved in this program, which assists teachers in the successful implementation of the curriculum and in the use of the DOE facilities. This program demonstrates to teachers and students how the curriculum study in the classroom relates to the real world scientific community and provides them with access to practicing scientists. For more information contact Cindy Musick, (202) 586-0987.

**National Science Bowl®**—The National Science Bowl® began in 1991 and is cosponsored by DOE and the Cray Research Foundation. It now involves up to 12,000 students per year from high schools throughout the Nation. Regional competitions are held at DOE and other facilities. The winning teams travel to Washington, D.C., for the finals, which are held in April during National Science and

Technology Week. Top prizes have included trips to London for the International Science Forum, science camps in National Parks, special training for teachers, and school link-ups with the National Education Supercomputer Program at Lawrence Livermore National Laboratory. For more information contact Rich Stephens, (202) 586-8949.

Students from Oakmont High School of Roseville, California, (left) compete against students from Mira Loma High School of Sacramento, California, (center) in the final round of the Sacramento District Competition for the Department of Energy National Science Bowl®. The Western Area Power Administration cosponsored the area competition.

**National Teachers Institute in Materials Science and Technology**—This annual, national program in materials science and technology was developed by Pacific Northwest Laboratory (PNL) and area teachers beginning in 1986 and is now part of their initiative for the FCCSET Federal Laboratory Teacher Training Program (see page 10). The summer institutes are composed of teams of teachers and administrators from seven school districts who work closely with mentor teachers and researchers from PNL. The teams consist of one high school science teacher, one high school technology teacher, one district administrator or counselor, and two middle school teachers. Each team is required to have the backing of its school district and of a local industry, university, or national laboratory. The seven school districts that participated in one summer's institute were located in San Francisco, California, Virginia Beach, Virginia, Stratford, Oklahoma, Grand Rapids, Michigan, Farmington, New Mexico, Boyertown, Pennsylvania, and Lawrence, New Jersey. Partners of school districts have included the Stanford Linear Accelerator Center, Los Alamos National Laboratory, the Princeton Materials Institute, Norfolk State University, the Grand Rapids Manufacturers Council, and Drexel University. During the 2-week institute, the teachers become student learners, discovering the properties of metals, glass and ceramics, composites, and polymers. Each teacher is encouraged to conduct experiments, explore his or her creativity, use the methods of scientific inquiry, and write and sketch in a journal to help in understanding the nature and behavior of materials. For more information, contact Irene Hays, (509) 375-2584.

Secondary school teachers Linda Peters and Pat Livingston of the Grand Rapids (Michigan) School District measure the properties of a glass during the DOE National Teachers Institute in Materials Science and Technology at Pacific Northwest Laboratory.

On their site visit to Argonne National Laboratory, students lunch with a scientist and discuss careers as part of the Chicago Science Explorers Program.

**New Explorers Partners**—DOE and Argonne National Laboratory are supporting many formal and informal education initiatives in conjunction with the third season of "The New Explorers with Bill Kurtis" on PBS. Thousands of students have had the New Explorers experience at the 15 Chicago Science Explorers sites. A New Explorers Partner at each site selected a group of teachers, scientists, and museum staff members who created a teacher's guide containing activities for students, background material, and career information that support the classroom use of one of the videos from the series and support activities for a field trip to the site. Similar cooperation is occurring in Boston among schools and the Museum of Science, the New England Science Center, and the New England Aquarium in the Boston area. In Washington, D.C., schools are working with the Smithsonian Institution through the Anacostia Museum and the National Zoological Park's New Opportunities in Animal Health Sciences (NOAHS) Center. Other cities, schools, and laboratories with similar programs include Central School in Somerville, New Jersey, and Princeton Plasma Physics Laboratory; Fernald Environmental Management Project and Cincinnati schools, zoo, and museums; SciTrek and Zoo Atlanta in Atlanta; and the Science Museum of Minnesota. For more information on this expanding nationwide program, contact Argonne National Laboratory's Division of Educational Programs at (708) 252-4114 for Chicago area programs and Kasse Andrews-Weller at (202) 586-8949 for national initiatives.

Bill Kurtis, host of "The New Explorers" on PBS, Sam Bowen of Argonne National Laboratory, and John Ormsby of Amoco Corporation congratulate Jim Moryan, Principal of Central School in Somerville, New Jersey, as he cuts the ribbon to the school's new science center, which features videotapes of the program and accompanying teacher's guides as part of the school's science curriculum.

**PreFreshman Enrichment Program (PREP)**—One national precollege program that is not held at the Department's national laboratories and facilities is the PreFreshman Enrichment Program (PREP). Participating institutions, primarily colleges and universities with science-based degree programs, conduct summer institutes for 6th to 10th grade students from groups typically underrepresented in math and science. The goal of these 4- to 8-week programs is to capture and retain student interest in science by guiding them to choose college-preparatory science and mathematics courses. The summer activities focus on encouraging students, particularly young women and minorities, to consider careers in science-related fields. PREP provides a number of enrichment experiences, including laboratory work, field trips, tutoring, and counseling. Institutions are encouraged to share the cost, using university, industrial, or other non-Federal support. This program reaches 6,000 students each summer. For more information contact John Ortman, (202) 586-1634.

**Preservice Teacher Enhancement Program (PRETEP)**—Four year colleges and universities are eligible to apply for DOE's PRETEP funds. PRETEP, through the funded institutions, focuses on precollege and/or college students who are majoring or will be majoring in math and science and encourages these students to pursue a career in precollege teaching. Some funded approaches include hands-on science experiences, teaching and curriculum development courses, mentors, fellowships, and real-life teaching experiences. Collaboration with local school systems, private industry scientific expertise, and museums; integration with State Systemic Initiatives (see page 27) and the National Education Goals (see page 4); and participation of women and minority students are encouraged. Guidelines and applications are available through DOE's Office of University and Science Education. For more information contact Cindy Musick, (202) 586-0987.

**Standard Model of Fundamental Particles and Interactions**—DOE, through Lawrence Berkeley Laboratory, Stanford Linear Accelerator Center, and the Superconducting Super Collider Laboratory, has sponsored production and distribution of this packet to provide teachers with some methods for presenting up-to-date ideas on quarks and leptons. The activities in this packet were designed by teachers working with leading physicists through the nonprofit Contemporary Physics Education Project. For information about ordering this packet, see the Other DOE Related Materials section, page 148.

**Students Watching Over Our Planet Earth (SWOOPE)**—Los Alamos National Laboratory (LANL) offers an environmental science curriculum through the use of special kits called SWOOPE Discovery Units. For example, units on Water Quality and Radiation contain

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Joanne Meldon of Taylor Allderdice High School in Pittsburgh, Pennsylvania, takes coal samples in an open-pit mine during the Teacher Institutes in Fossil Energy.

The Great Adventure amusement park in New Jersey provides a unique setting for a teacher to learn about and describe the forces of motion as she participates in the Teacher Research Associates (TRAC) Program at the Princeton Plasma Physics Laboratory.

scientific instruments and instructional materials for teachers and students. The units allow students to gather data on an item of concern in the environment and send the data to a database at LANL. Follow-up reports to the students emphasize their role in a serious effort to map an environmental parameter of concern to the Nation. Teachers play an active role by interacting with scientists and writing the curriculum materials at summer institutes. Other teachers are trained in the hands-on science techniques via workshops. By taking measurements on the environment and contributing their results to the database, students are truly part of a collaborative scientific effort. In the full implementation of the SWOOPE program, information can be shared with scientists, teachers, and students across the country through distributed databases. Nationwide SWOOPE workshops are cosponsored by the Environmental Protection Agency (EPA) under the auspices of a special DOE/EPA Memorandum of Understanding. For more information contact Cindy Musick, (202) 586-0987.

**Teacher Institutes in Fossil Energy**—The Teacher Institutes in Fossil Energy are supported by DOE's Office of Clean Coal Technology. They are designed to increase teacher and student understanding of coal as an energy source. The sessions emphasize clean-coal technologies and provide information to encourage students to pursue careers in science and mathematics. Nationally, teachers from inner-city schools or from schools with populations underrepresented in science and engineering are invited to participate. Each institute accommodates 25 teachers from grades 5 through 12 and lasts 5 days. The institutes include lectures, group discussions, and field trips. For more information contact Wayne Stevenson, (615) 576-3283.

**Teacher Research Associates (TRAC) Program**—Under this nationally competitive program, 7th through 12th grade teachers representing each State are selected to participate in special 8-week summer research programs at selected laboratories. Teachers may apply directly to the Associated Western Universities, which administers the program for DOE. Each year, more than 350 teachers participate, about half of whom are women. The teachers serve on research teams, where most of their time is spent improving research skills and laboratory techniques. Most of the participants also prepare instructional materials and experiments to take back to their classrooms. This program increases teacher awareness and understanding of current science and technology and promotes transfer of new knowledge to the classroom. In some cases, the program provides an opportunity to receive college credit. For more information contact John Ortman, (202) 586-1634.

**Young Scholars Alert Program**—The National Renewable Energy Laboratory (NREL) participates in the Young Scholars Alert Program at the Colorado School of Mines. This national 3-week math initiative program provides students with hands-on math activities. The program teaches problem-solving skills in three areas of math instruction: computers/robotics, energy/environment, and rockets/space. The target population is Native American junior high students and teachers. The teachers participate in in-service training, and both the students and teachers learn about different sources of energy and build and race model solar cars with NREL staff assistance. For more information contact Linda Lung, (303) 231-7044.

Native American students built and raced their own solar cars at the Colorado School of Mines as part of the National Renewable Energy Laboratory's Young Scholars Alert Program.

## REGIONAL BY LABORATORY OR FACILITY

### Bates Linear Accelerator Center

**Nuclear and Particle Physics for High School Teachers**—This program, conducted at the Bates Linear Accelerator Center of the Massachusetts Institute of Technology, is funded by the National Science Foundation. Its purpose is to enhance teaching through programs with an emphasis on particle physics, related applications, and nuclear technology. The program includes facility tours, an internship opportunity for local high school students, and Center staff and graduate students judging science fairs.

### Bonneville Power Administration

**Energy Source Curriculum**—Bonneville Power Administration, four local utilities, and the local American Nuclear Society chapter formed a partnership to fund and distribute the Energy Source Curriculum for grades K-6.

### Continuous Electron Beam Accelerator Facility

**Becoming Enthusiastic About Math and Science (BEAMS)**—The Continuous Electron Beam Accelerator Facility (CEBAF) launched the BEAMS program with local schools in 1991. BEAMS brings inner-city 5th and 6th grade classes with their teachers to CEBAF for an entire week, during which they participate in a specially modified version of their regular academic week. Each day, the participants are immersed in CEBAF's research environment and experience science events; activities; computers; and numerous contacts with scientists, engineers, and technicians. Follow-up training for teachers and CEBAF staff visits to school classrooms reinforce the immersion experience. Each year more than a thousand students and their teachers participate in BEAMS.

### Fermi National Accelerator Laboratory

**Particles and Prairies**—Particles and Prairies is an exciting addition to the Fermi National Accelerator Laboratory teacher

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workshop offerings. Particles and Prairies provides a close, hands-on look at the abiotic and biotic aspects of the prairie, the savannah, and the aquatic environments of Fermilab. Teachers attending this workshop learn how to use standard ecological measurement techniques and biological principles to teach their students how to assess and compare different habitats. Background information on the natural areas of Fermilab and indigenous species is also provided. After attending this workshop, teachers can schedule field trips to the Leon M. Lederman Science Education Center for their students. During these visits, teachers can lead their students in both lab and field activities from the Particles and Prairies curriculum. Two hours of graduate credit are available.

Students take soil samples as part of Particles and Prairies, a program that provides a close-up look at the abiotic and biotic aspects of the prairie, savannah, and aquatic environments of Fermilab.

**Fernald Environmental Management Project**
**Council for Advancement of Science**—The Fernald Environmental Management Project is active in this tristate organization composed of educators, universities, and industries in Indiana, Kentucky, and Ohio. The mission is to provide a forum for exchanging ideas for the betterment of math, science, and technology education. Goals of the organization are to increase awareness of education efforts for K–12, encourage possible collaborations with others, initiate regional projects, and disseminate education materials.

**Idaho National Engineering Laboratory**
**Physical Sciences Revisited for Intermountain Educators (PRIME)**—This Idaho National Engineering Laboratory program offers junior high school physical science teachers an opportunity to refresh their skills. The 5-day workshop curriculum is demonstration oriented and designed to review matter, energy, waves, and electromagnetism and cover other topics in physics, such as "The Physics of Toys," "Powers of Ten," and "Special Relativity." Participants return to their schools with inexpensive equipment needed to implement PRIME in their classes.

**Inhalation Toxicology Research Institute**
**Summer Teacher Enrichment Program (STEP)**—The Inhalation Toxicology Research Institute's (ITRI) Summer Teacher Enrichment Program (STEP) provides information, intellectual support, and some supplies and equipment to allow teachers to carry out experiments not possible without the laboratory's assistance. In addition, staff members make presentations and conduct classroom experiments. Follow-up measurements are made with instrumentation available at ITRI. The teachers and their students follow up with a visit to the laboratory to see the scientists in their work environment.

**Morgantown Energy Technology Center**
**Morgantown Energy Technology Center (METC) Education Resource Center**—The METC Education Resource Center evaluates and demonstrates hands-on science and mathematics teaching materials for local school systems. Through this activity, METC provides (1) curriculum materials, including teacher's guides and materials kits for teachers to evaluate and test in their classrooms, and (2) scientific and engineering expertise to assist teachers in learning and teaching the concepts. The Center also develops science and energy modules for use in school visits or METC tours.

**Mound Facility**

**Science Demonstration Program**—At DOE's Mound Facility, five scientific demonstrations in physical chemistry, chemical reactions, lasers and optics, electricity and magnetism, and radioactivity have been developed. Seventeen Mound scientists take these demonstrations into classrooms and other venues, such as science camps and libraries, for hands-on interactions with students in grades 1–12. Using the Science Demonstration Program as a model, Mound developed the New Futures Program with the Dayton (Ohio) Urban League. New Futures employs interactive science demonstrations to significantly augment the standard textbook curriculum for middle school students in inner-city schools.

**Oak Ridge National Laboratory**

**Alternative Certification for Math and Science Teachers**—The University of Tennessee, Knoxville, in association with Oak Ridge National Laboratory, has developed a program in alternative certification of science and mathematics teachers for rural school districts. The purpose is to encourage and support scientifically and technically trained professionals to pursue new or second careers as precollege science and mathematics teachers.

**Oak Ridge National Laboratory**

**Tennessee Academy for Teachers of Science and Mathematics**—Each summer teachers from private and public schools in Tennessee, Kentucky, North Carolina, Florida, Louisiana, and Canada participate in this in-residence program at The University

Renee Keyes from Florida, Regena Maxwell from Florida, and Jim Woody from North Carolina tackle a problem in knot theory at the Tennessee Academy for Teachers of Science and Mathematics at The University of Tennessee, Knoxville.

of Tennessee, Knoxville. With additional support from DOE, Oak Ridge National Laboratory, Martin Marietta Energy Systems, Inc., the Tennessee State Department of Education, and The University of Tennessee, these teacher participants then work with active researchers to produce hands-on, problem-solving adventures that they can take back and use in the classroom. In addition, the teachers experience interdisciplinary teamwork in action.

**Oak Ridge National Laboratory**
**Wesleyan Math and Science Spectacles**—With the assistance of Oak Ridge National Laboratory (ORNL) and DOE, Wesleyan College in Macon, Georgia, sponsors math and science camps each summer for upper elementary and junior high girls from many States in the Southeast. During their 2 weeks in residence, the girls have an opportunity to meet with women whose careers involve math and science. The girls also visit ORNL and cultural institutions as part of their summer experience.

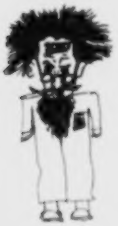
The Wesleyan Math and Science Spectacles group visited the Freels Bend Environmental Site in Oak Ridge, Tennessee, to study the flora and fauna.

**Pacific Northwest Laboratory**
**OPTIONS**—Pacific Northwest Laboratory (PNL) began the OPTIONS program in the spring of 1990 as a part of DOE's plan of action to revitalize mathematics and science education. OPTIONS links the unique human and technical resources of PNL with students and teachers in Oregon and with Washington middle schools that have large numbers of Hispanic, African-American, and American Indian students. The goals of the program are to help middle school students see that science offers options for an exciting, stimulating, fulfilling life's work and to provide teachers with options for teaching science, mathematics, and technology. Teachers receive staff and curriculum development, and students

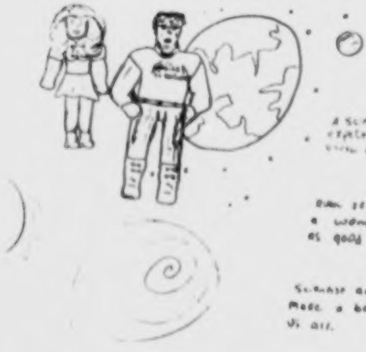
Richard Arthur shows students how to hammer a peg into a board with a banana in his cryogenics demonstration that is part of the Science and Technology Days at OPTIONS middle schools in Washington and Oregon.

Students have different conceptions of scientists before and after their experiences in the OPTIONS program at Pacific Northwest Laboratory.

meet with scientist mentors for activities in science, mathematics, and technology. OPTIONS is proposed to be expanded to support the Washington State Systemic Initiative. For more information contact Irene Hays, (509) 375-2584.



I think a scientist is a person that never played any sports was a nerd in school and didnt have any friends because he was always working on science projects he wears white jacket is half bald and wears thick wired glasses his only joy in life is to discover something New or buy a used pocket protector for a quarter. has shiny formal black shoes 12 pens in 4 pencils in his right front pocket in his left pocket he has a white pile of rubber [illegible]



A scientist looks like any person except that a scientist studies the earth & space, and tries to help the environment

Even if a scientist is a women shes just as good as a man!

Scientist are trying to make a better future for us all.

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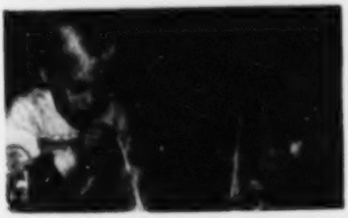
**Pittsburgh Energy Technology Center**
**Triple E Seminar**—Annually the Pittsburgh Energy Technology Center (PETC) offers a multidisciplinary seminar that covers energy, environmental, and economic issues on regional, national, and global levels. The Triple E Seminar is designed with hands-on activities for classroom teachers at the primary and secondary levels and is being organized by PETC in close collaboration with the Allegheny Intermediate Unit and the Community College of Allegheny County.

**Princeton Plasma Physics Laboratory**
**Princeton Plasma Physics Laboratory–Trenton Public Schools Partnership**—The Princeton Plasma Physics Laboratory (PPPL) formed an educational alliance with the Trenton, New Jersey, school system, which is 80% minorities and whose high schools experiences a 50% dropout rate. The lab staff provides teacher-enhancement programs, loans or grants of equipment and materials, in-classroom lectures and demonstrations, science fair assistance and judging, and special tours. PPPL staff are assisting the district in revising its science and math curriculum, in developing plans for science magnet schools, and in evaluating student and teacher attitudes toward science. PPPL supports 10 Princeton University undergraduates who provide tutoring and/or science and math instruction to Trenton children in community programs during the summer.



Princeton Plasma Physics Laboratory–Trenton Public Schools Partnership gives these two kindergarten students an opportunity to enjoy a bubbles experiment.

**Rocky Flats Plant**
**Exploratory Technology Laboratories Program**—DOE's Rocky Flats Plant is joining in educational partnerships with school districts in the Denver area to implement exploratory technology laboratories in the schools' industrial arts programs. These laboratories consist of workstations where students obtain career information and conduct hands-on exploration of a wide range of high technology areas from robotics to transportation and environmental management. Students learn the concepts underlying

technological systems in a setting featuring self-motivation and problem solving. Rocky Flats is providing funds for several pilot laboratories. Plant employees actively participate in the program by developing a curriculum and offering classroom demonstrations and teacher training. The partnership brings together top engineers and industry professionals with area children and teachers to enhance science and technology education.

**Sandia National Laboratories/California**
**Science/Math Carnival**—This traveling carnival featuring up to 14 hands-on activities presents basic scientific concepts in an exciting way to students in grades K–8. Staffed by Sandia National Laboratories/California volunteers who provide positive and diverse role models, the carnival shows that science is fun and exciting and is a source of encouragement for both teachers and students. Pre- and post-carnival curriculum materials are being developed to expand classroom learning opportunities. In a 12-month period, the Science/Math Carnival typically visits approximately 80 schools, involving more than 1,300 teachers and 400,000 students.

Clyde Taylor encourages students to explore the world of the microscale through optical microscopes as a part of Sandia National Laboratories/California's traveling Science/Math Carnival.

**Sandia National Laboratories/New Mexico**
**Science Advisors (SCIAD) Program**—Sandia National Laboratories/New Mexico is working to improve mathematics and science education in Native American schools, including Tribal Schools, in New Mexico, Arizona, and Utah and in the predominantly Hispanic schools of the Albuquerque public school system. Through Sandia's SCIAD Program, scientists serve as resources to teachers and as role models to students. Science Advisors spend up to 1 day a week for the entire school year working to enhance science and mathematics education.

**Savannah River Ecology Laboratory**
**Environmental Outreach and Education Program**—Savannah River Ecology Laboratory's Environmental Outreach Program enhances public awareness of DOE ecological research and environmental issues by taking ecological information into the community through media exposure and the preparation of high-quality laboratory publications.

## OTHER: CONDUCTED BY DOE HEADQUARTERS, FIELD OFFICES, OR BY MORE THAN ONE LABORATORY OR FACILITY

**Bay Area Science and Technology Education Collaboration (BASTEC)**—BASTEC is a multilaboratory regional initiative to improve science, mathematics, and technology education in grades K–12 of the 55,000 student Oakland Unified School District (OUSD). Partners in the program include four DOE facilities (Lawrence Berkeley Laboratory, Lawrence Livermore National Laboratory, Stanford Linear Accelerator Center, and Sandia National Laboratories/California), universities, and community-based organizations. All 92 schools in the district participate in the program, which involves teacher enhancement workshops, student activities, research participation opportunities, a resource center, a newsletter, grants, and a conference. BASTEC is an integral part of the district science curriculum development committee and works with OUSD to provide a well-articulated program for the entire district.

**Emeritus Scientists, Mathematicians, and Engineers (ESME) Program**—The Emeritus Foundation began this program in the Washington, D.C., metropolitan area in September 1989. That year, it placed six volunteers in two schools. Now, with the help of pilot funding from DOE and a 3-year grant from the National Science Foundation, ESME has more than 30 volunteers helping in 8 schools. DOE's contribution helped the scientists develop a regular orientation program and a handbook for new volunteers. With the assistance of an evaluation process, the program's direction has been expanded to establish workshops for elementary school teachers in which they learn to develop their own sets of class experiments. This program plans replication in six cities.

Mrs. Prince's first graders at Phoebe Hearst Elementary School in Washington, D.C., fly paper airplanes and test the aerodynamics of paper models under the guidance of Emeritus engineer T. Paul Torda.

**Science and Mathematics Action for Revitalized Teaching (SMART)**—The DOE facilities in Oak Ridge, Tennessee, established SMART, which links three local school systems in Chattanooga and Roane County with Oak Ridge Institute for Science and Education (ORISE) and Oak Ridge National Laboratory (ORNL). Scientists and staff at ORISE and ORNL, in partnership with local business and industry, work closely with school teachers, counselors, and administrators to increase the effectiveness of K–12 science and mathematics education. This comprehensive, multiyear program is intended to reach every teacher and student in the participating districts with research appointments, workshops, and summer camps. In addition, a number of DOE laboratory employees volunteer their time for this initiative.

**State Systemic Initiatives (SSI)**—DOE is providing assistance to several State Systemic Initiatives (SSIs) to improve science, mathematics, and technology education. An SSI can be described as having a unifying vision and goal, a coherent system of instructional guidance, and a restructured governance system. DOE Headquarters, its laboratories, and its facilities have participated in the development of new SSI proposals, and approximately 18 DOE field offices and facilities are playing key support roles in SSI programs previously funded by the National Science Foundation. The involvement of DOE in an SSI ensures that DOE's education programs are closely coordinated with the education efforts across the State and thus ensures that DOE is not working at cross-purposes with a State's attempts to upgrade the teaching of science, mathematics, and technology. States to which SSI assistance is being rendered include California, Idaho, Illinois, Louisiana, New Jersey, New Mexico, Nevada, South Carolina, Tennessee, Virginia, and Washington.

**Successful Teaming for Educational Partnerships in Science (STEPS)**—STEPS has succeeded through the cooperation of DOE employee volunteers; the District of Columbia schools; parents; and Hands-On Science Outreach, Inc. Three sessions are convened during the year; the participating students conduct safe, simple experiments that help them explore their world. The subjects covered range from anatomy, botany, chemistry, and physics to the science in music, art, toys, literature, and games. Supported by DOE funding, STEPS has expanded into other locales nationwide.

Ramon Martinez-Morales from Naranjito, Puerto Rico, a participant in the Summer Educational Experiences for the Disadvantaged (SEED) program, conducted his research project on the effects of temperature on the growth and survival of Hydropsyche depravata. Here, he discusses the progress of his project with Virginia Tolbert of Oak Ridge National Laboratory's Environmental Sciences Division.

**Summer Educational Experiences for the Disadvantaged (SEED)**—A number of DOE facilities are involved in this 8- to 10-week summer program that encourages economically disadvantaged high school juniors and seniors to consider careers in science and mathematics. The program pairs students with a mentor and includes research participation and educational activities in local academic, industrial, and government chemistry laboratories. The students participate in ongoing research, experience career education activities, and prepare an essay describing their summer research.

**Teacher Opportunities to Promote Science (TOPS)**—The TOPS program was developed by Los Alamos and Sandia National Laboratories/New Mexico to enhance the skills of middle school science and mathematics teachers in the rural areas of the State with large Hispanic and Native American populations. The 3-year program provides a summer training institute at the laboratories, academic year activities, and classroom visits, as well as teacher research experiences at the two DOE laboratories.

**World in Motion**—AlliedSignal engineers have gone back to elementary school with the World in Motion program in Kansas City. The program places volunteer engineers in the classroom to help 4th, 5th, and 6th grade students understand physical science. The engineers meet with the classes on a regular basis to discuss science and math and explain what it is like to be an engineer. The program is currently being used in over 60 schools in the Greater Kansas City area with over 60 AlliedSignal volunteers working on the project. The program was developed by the Society of Automotive Engineers, is partially funded by the AlliedSignal Foundation, and is affiliated with DOE's Kansas City Area Office.

## Undergraduate Programs

The Department of Energy has been a strong supporter of undergraduate education since the earliest days of the Atomic Energy Commission. DOE activities in undergraduate education are aimed at improving and developing college curricula in science, engineering, and mathematics; preparing faculty for teaching state-of-the-art scientific and technical subjects; providing support, incentives, and opportunities to undergraduate students; supporting research, dissemination, and technical assistance for innovative and effective means of teaching science, mathematics, and engineering at the undergraduate level; and fostering the reform of undergraduate educational institutions. Some representative undergraduate programs are described briefly in this section.

**Cooperative Developmental Energy Program (CDEP)**—Since 1983, the Fort Valley State College (FVSC) in Georgia has received funding from DOE's Office of Minority Economic Impact to implement an innovative energy education program that has increased the number of minorities and women working in the private and governmental sectors of the energy industry. Students interested in dual degree programs may apply for competitive scholarships up to $26,700 in mathematics/electrical engineering with the University of Nevada at Las Vegas or dual degrees in mathematics or chemistry/geosciences with the University of Oklahoma. Students enroll at FVSC for 3 years and major in mathematics, then transfer to one of the other universities for their other major. For more information contact Annie Whatley, (202) 586-1593.

Students from Fort Valley State College in Georgia visit Hoover Dam as part of their academic curriculum in the DOE-sponsored Cooperative Developmental Energy Program.

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Richard Stephens, Director, Department of Energy Office of University and Science Education, and José Luis Rodriguez, President, Hispanic Information and Telecommunications, Inc., of New York City, review DOE's electronic Minority On-Line Information Service (MOLIS) at a Washington, D.C., conference sponsored by the Hispanic Association of Colleges and Universities (HACU).

Gallaudet University biology student Eva Holloway worked with the boron-neutron-capture-therapy group at Brookhaven National Laboratory as part of a program to enhance science education for the hearing impaired.

**Environmental Restoration and Waste Management Scholarship Program**—This program provides undergraduate students with tuition, fees, and a monthly stipend to study in scientific fields supportive of DOE's environmental-restoration and waste-management activities. Scholarships can be held at designated colleges and universities and involve practical experience at a DOE facility during the summer. Information about this program can be obtained from Isiah Sewell at (301) 903-7643.

**Federal Information Exchange (FEDIX) and Minority On-Line Information Service (MOLIS)**—The Department of Energy, in cooperation with other Federal agencies, has developed two database retrieval services to provide the academic community with timely, no-cost information on research and education programs. Those databases are FEDIX and MOLIS. They provide information on faculty and student research-participation opportunities, faculty research visits, visiting staff lectures, conferences, institutes, workshops, and fellowships at undergraduate through postgraduate levels. Other information of interest to faculty, administrators, and students is also available on FEDIX. In addition, MOLIS provides information of particular interest to historically black colleges and universities or other institutions with large populations of minority students.

This information is accessible through standard telecommunications technology. Anyone with a computer, phone, and modem can access FEDIX and MOLIS 24 hours a day at no cost. General information about the system can be obtained from Federal Information Exchange, Inc., at (301) 975-0103. The systems can also be accessed directly at (800) 75FEDIX with any 1200-baud modem set to no parity, eight bits, and one stop bit.

**Gallaudet University Program**—This program provides hearing-impaired students and faculty from Gallaudet University in Washington, D.C., with summer research appointments at Brookhaven National Laboratory (BNL). Participants engage in intensive research under the guidance of BNL scientists. Among other benefits, this unique effort demonstrates ways to adapt the laboratory working environment for hearing-impaired researchers. For more information contact Karl Swyler, (516) 282-7171.

**Minority Access to Energy-Related Research Careers (MAERC)**—The MAERC program is a collaborative effort of the Associated Western Universities (AWU) and the California State University (CSU) system, undertaken with the sponsorship of DOE and in partnership with four DOE laboratories in the western United States: Idaho National Engineering Laboratory, Lawrence Berkeley Laboratory, Los Alamos National Laboratory, and the National Renewable Energy Laboratory. The four participating CSU campuses are Los Angeles, Northridge, San Diego, and San Jose. The purpose of the MAERC program is to identify, encourage, and support outstanding underrepresented minority CSU students enrolled in science or engineering. The program seeks to increase the number of minority students pursuing advanced degrees in these fields and to interest these students in energy-related research careers. Summer research internships are provided for MAERC students at DOE laboratories. For more information contact Larry Barker, (202) 586-8947.

**Minority Honors Training and Industrial Assistance Program**—This program seeks to increase the number of minority students pursuing energy-related technology programs at 2-year colleges by providing scholarships and other assistance. Students study such fields as computer science, electronics, and engineering sciences. The support for this program is provided by DOE's Office of Economic Impact and Diversity. For more information contact Annie Whatley, (202) 586-1593.

**Minority Institution Laboratory Alliances**—DOE national laboratories have formed a number of alliances with historically black colleges and universities (HBCUs) and minority institutions (MIs) to (1) provide comprehensive and long-term technical assistance designed to upgrade their research and teaching capabilities and (2) attract minority students to, and retain them in, scientific and technical careers. Activities include student research opportunities, visiting-scientist programs, academic support systems for minority students, seminars, new-course-development assistance, equipment loans, and other support.

Examples of these alliances formed with DOE laboratories include the Science Consortium among Lawrence Berkeley National Laboratory and Jackson State University and the Ana G. Mendez Educational Foundation of Puerto Rico, which administers three private universities; the Science and Technology Alliance among Sandia National Laboratories/New Mexico, Los Alamos National Laboratory, and Oak Ridge National Laboratory and North Carolina Agricultural and Technical State University and New Mexico Highlands University, and the Ana G. Mendez Foundation; and the Science and Engineering Alliance among Lawrence Livermore National Laboratory and Alabama A&M, Prairie View A&M, Jackson State, and Southern Universities. Another unique alliance, the Environmental Technology and Waste Management Consortium, includes 17 minority institutions that conduct research and education related to environmental management. Many major DOE laboratories participate in this consortium. For more information contact Donna Prokop, (202) 586-8910.

Nitza Lopez from Turabo University in Puerto Rico worked in the laboratories of the Cell and Molecular Biology Division at Lawrence Berkeley Laboratory as part of the training she received through the Science Consortium of the Minority Institution Laboratory Alliances.

**Minority Undergraduate Training for Energy-Related Careers (MUTEC)**—This campus-based program sponsored by DOE's Office of Environmental Restoration and Waste Management seeks to increase the number of minority students selecting courses of study that specifically lead to energy-related careers. Institutions receive grants to strengthen or create energy-related undergraduate research programs. Students receive scholarship assistance, summer job opportunities at DOE and industrial labs, and mentoring and counseling on future career and educational options. Faculty members at participating institutions are also involved in research on energy-related topics. For more information contact Georgia Johnson, (202) 586-1593.

**National Undergraduate Fellowships in Plasma Physics and Fusion Engineering**—Junior or exceptional sophomore students studying engineering, mathematics, computer science, or physics in U.S. colleges and universities may apply for this fellowship. The selected students will participate in an introductory course in plasma physics at Princeton Plasma Physics Laboratory and then spend 9 weeks conducting fusion research at one of the participating universities and national laboratories. For more information contact Dave Crandall, (609) 243-2546.

**Native American Scholarship Program**—Cosponsored by DOE's Office of Environmental Restoration and Waste Management and the Johnson & Johnson Company, the Native American Scholarship Program encourages Native Americans and other historically disadvantaged students to pursue technical degrees at community colleges in such fields as environmental restoration and waste management. For more information contact Georgia Johnson, (202) 586-1593.

**Nuclear Energy Training Program**—Designed to assist students attending historically black colleges and universities (HBCUs), the Nuclear Energy Training Program supports training, study, research participation, and academic enrichment of students and faculty in nuclear-related disciplines at HBCUs. The program is sponsored by the DOE Office of Nuclear Energy and is administered by the Oak Ridge Institute for Science and Education. Some opportunities are also available for graduate students. For more information contact Phil Garon, (202) 586-6823.

**Partnership for Environmental Technology Education (PETE)**—The DOE Offices of Science Education and Technical Information and Environmental Restoration and Waste Management support a Community College Environmental Education Program to enhance the education and training available to students in 2-year community colleges. One activity under this program is the Partnership for Environmental Technology Education, which is designed to provide an ongoing Environmental/Hazardous Materials Technician curriculum and corresponding Instructor Institutes. Community colleges in Arizona, California, Hawaii, Nevada, and Utah have received assistance in adopting this curriculum through accelerated instructor training and creative approaches to ensuring the availability of appropriate state of the art equipment. For more information contact Cindy Musick, (202) 586-0987.

Partnership for Environmental Technology Education (PETE) interns at Nevada Test Site examine the effects of a weapons test bomb blast on a bank vault.

**Science and Engineering Research Semester (SERS)**—DOE's SERS program provides opportunities for undergraduate science and engineering students to participate in research at the cutting edge of science at seven of DOE's laboratories. Students receive support for research appointments for an academic term at one of the following institutions: Argonne National Laboratory, Brookhaven National Laboratory, Lawrence Berkeley Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, and the Pacific Northwest Laboratory. Students participating in the SERS program work with national laboratory scientists in ongoing research and have access to state-of-the-art research equipment and facilities. Seminars, workshops, and coursework are also conducted in the student's chosen field of study. For more information contact Donna Prokop, (202) 586-8910.

A DOE Science and Engineering Research Semester (SERS) student visits with her mentor and assisting staff member at the Los Alamos National Laboratory SERS poster session and reception.

Sun Hawk won the award for best design in a Junior Solar Sprint Competition in which teams from local junior high schools competed in 100-yard races with solar-powered model cars. Argonne National Laboratory's Energy Systems Division conducts this event.

**SunRayce and Other Vehicle Competitions**—DOE's Office of Energy Efficiency and Renewable Energy sponsors an annual SunRayce for university students, which includes classroom instruction; vehicle design, construction, and testing; and a national solar-vehicle competition. A similar competition for methanol and natural gas vehicles is supported, as well as the Junior Solar Sprint a version of the SunRayce for junior high students. For more information contact Richard King, (202) 586-1693.

**Undergraduate Student Research Participation (SRP)**—Through the University–DOE Laboratory Cooperative (Lab Co-Op) Undergraduate Student Research Participation (SRP), appointments are available to qualified undergraduate science and engineering students. These students participate in research, development, and demonstration programs, often during the

Ceramics section group leader, Roger Poeppel, involves undergraduate students as part of the Student Research Participation Program in his research at Argonne National Laboratory.

summer, at DOE facilities. Each DOE facility or affiliated university consortium selects and appoints student participants in this program. These research appointments provide a valuable learning opportunity as well as practical, hands-on experience that is relevant to the students' career aspirations. For more information contact Larry Barker, (202) 586-8947.

**University Partnerships for Environmental Restoration and Waste Management Research and Development and Education**—A major initiative of the Office of Environmental Restoration and Waste Management, this program supports partnerships among universities, industry, and laboratories to update curricula, expand course offerings, develop faculty, increase public and student awareness, and increase the number of professionals, especially technicians, in the growing field of environmental restoration and waste management. In a related project, the Savannah River Technology Center, through the South Carolina University Research and Education Foundation, has established 4-year undergraduate scholarships for women and underrepresented minorities to obtain science and engineering degrees in environmental restoration and waste management. For more information contact Isiah Sewell, (301) 903-7643.

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## Graduate Programs

DOE support for graduate, postgraduate, and faculty programs is aimed at enhancing educational experiences in science, engineering, and mathematics; providing support, incentives, and opportunities to graduate and postgraduate students; and supporting research, dissemination, and technical assistance for the development of innovative and effective means of teaching science, mathematics, and engineering at the graduate level. Faculty programs strengthen the capabilities of faculty members to conduct energy-related research. Some representative graduate programs are described briefly in this section.

**Designated Scientific User Facilities**—DOE laboratories house many Designated Scientific User Facilities, large experimental facilities which are made available to students and faculty for research. Proposals for use of the facilities are submitted and peer reviewed for quality and appropriateness before access is approved and scheduled. DOE staff assigned to the user facility collaborate in the experiments. Just a few of the more than 60 designated user facilities are the Materials Preparation Center at Ames Laboratory; the Advanced Photon Source (under construction at Argonne National Laboratory); the National Synchrotron Light Source at Brookhaven National Laboratory; the 1,000-GeV Superconducting Accelerator System at Fermi National Accelerator Laboratory; the

Advanced Light Source (under construction at Lawrence Berkeley Laboratory); the National Magnetic Fusion Energy Computation Center at Lawrence Livermore National Laboratory; the Manual Lujan, Jr., Neutron Scattering Center at Los Alamos National Laboratory; the High-Temperature Materials Laboratory at Oak Ridge National Laboratory; the Hanford Environmental Research Park at Pacific Northwest Laboratory; the Solar Thermal Test Center at Sandia National Laboratories/New Mexico; and the SLC, a 100-GeV Linear Electron/Positron Collider at Stanford Linear Accelerator Center. Other user facilities, along with the educational program contacts, are identified in the Facility Descriptions section of this catalog.

**Faculty Research Participation**—Summer and sabbatical-year appointments are available through the University–DOE Laboratory Cooperative (Lab Co-Op) Faculty Research Participation Program at DOE facilities. Appointments enable faculty members to collaborate in ongoing research or to carry out independent research using the facilities and equipment at the host laboratory. Participants must be full-time faculty members with a commitment to continue teaching and/or research. For more information contact Larry Barker, (202) 586-8947.

**Faculty/Student Team Research**—Also through the University–DOE Laboratory Cooperative Program, DOE supports the participation of about 50 teams per year, consisting of a faculty member and a small group of undergraduate and graduate students, in ongoing team research at participating DOE facilities. Participants collaborate with senior staff at the host facility through summer or academic-year appointments in the Faculty Research Participation and Graduate Student Research Participation Programs. For more information contact Larry Barker, (202) 586-8947.

**Graduate Fellowships**—Graduate students are eligible for fellowship support to pursue graduate degrees in a variety of energy-related fields at designated colleges and universities. The fellowships provide for the payment of tuition, fees, and a monthly stipend for up to 4 years of graduate study. Practicum assignments at DOE laboratories are also arranged for at least one summer during the fellowship period. The fellowship programs listed below are supported by DOE's Offices of Energy Research; Environmental Restoration and Waste Management; Health and Environmental Research; Fusion Energy; Nuclear Energy; Environment, Safety and Health; and Civilian Radioactive Waste Management.

Applied Civilian Health Physics Fellowships
Computational Science Fellowships
Environmental Restoration/Waste Management Fellowships
Graduate Fellowships for Global Change
Magnetic Fusion Energy Technology Fellowships

Magnetic Fusion Science Fellowships
Nuclear Engineering and Health Physics Fellowships
Radioactive Waste Management Fellowships

The Computational Science Fellowship Program is administered by Ames Laboratory. Call (515) 294-9682 for information about this program. Information about all other DOE national graduate fellowship programs is available from the Oak Ridge Institute for Science and Education at (615) 576-3381.

**Graduate Student Research Participation**—Under the University–DOE Laboratory Cooperative (Lab Co-Op) Graduate Student Research Participation (GSRP) Program, full-time graduate students enrolled in accredited universities may receive research appointments of up to 1 year (renewable to a maximum of 3 years for Ph.D. students). The appointments allow them to carry out research in residence at a DOE facility. The purpose of the program is to provide graduate students with access to facilities not available on campus. For more information contact Larry Barker, (202) 586-8947.

**Graduate Student Thesis Research Participation Program**—Through the University–DOE Laboratory Cooperative (Lab Co-Op) Graduate Student Thesis Research Participation Program, full-time on-campus graduate students have an opportunity to conduct short-term portions of their research, a few days to several weeks, at a DOE facility. Appointments in this program make it possible for graduate students to work with special resources or scientific equipment required for their studies. For more information contact Larry Barker, (202) 586-8947.

Doctoral student Joe Pechmann collects amphibian samples from pit traps on the Savannah River Site as part of a long-term study of population sizes.

**International Student Exchange Program**—Cosponsored by DOE and the American Nuclear Society, this program arranges and supports the bilateral exchange of U.S. graduate students with the countries of France, Germany, and Japan. Annually about 10 students from the United States visit European and Japanese universities and research institutes, and an equal number of foreign students visit Argonne National Laboratory at different times of the year. More information about this program can be obtained by contacting Argonne National Laboratory, Division of Educational Programs, at (708) 252-4114.

**Postgraduate Research Programs**—Postdoctoral research appointments to conduct research at a DOE facility are available through several national programs sponsored by DOE's Offices of Energy Research, Health and Environmental Research, Fossil Energy, and Fusion Energy. These programs support postgraduate study in specified areas of interest to DOE. Appointments are available each year through the following programs:

Alexander Hollaender Distinguished Postdoctoral Fellowships (Life and Environmental Science)
DOE Distinguished Postdoctoral Research Program (Physical Science, Engineering, and Math/Computational Science)
Fossil Energy Postgraduate Research Training Program
Fusion Energy Postdoctoral Research Program
Global Change Distinguished Postdoctoral Fellowships
Human Genome Distinguished Postdoctoral Fellowships

Additional information about these national DOE postdoctoral programs is available from the Oak Ridge Institute for Science and Education at (615) 576-1089.

Individual laboratories offering postgraduate research opportunities are shown on matrices in the Facility Descriptions section of this catalog. Contact the education office at each facility directly for information about the programs at that facility.

**University Reactor Fuel Assistance**—For more than 25 years, university-based reactors have played a prominent role in the Nation's training and research in nuclear science and engineering. They are also widely used in the study of chemistry, physics, geology, biology, and materials sciences. Currently, 33 university research and training reactors are operating in the United States. The Department loans universities the fuel needed to operate these reactors and also provides funding for fabricating fuel elements. In addition, the Department provides reactor-sharing grants to universities that make their reactors and analytical facilities available to educational institutions lacking such resources. For more information contact Larry Barker, (202) 586-8947.

**University Research Instrumentation (URI) Program**—This program provides financial assistance on a competitive basis to university research groups for the purchase of sophisticated, state-of-the-art research instrumentation required for advanced energy research. Participation in the URI program is limited to universities and colleges in the United States that have active, DOE-funded research projects of a minimum of $150,000 during the past 2 fiscal years in the research area for which the application is being submitted. The objective of the URI program is to strengthen the ability of universities and colleges to conduct long-range, energy-related research by helping them acquire specialized research instrumentation. Award recipients are selected on technical merit from responses to annual solicitations for applications. Although all energy research areas are eligible, examples of the state-of-the-art instruments provided under this program are a confocal laser scanning light microscope at Cornell University, a scanning tunneling microscope at the University of Virginia, an X-ray photoemission spectroscopy system at California Institute of Technology, and an electron paramagnetic resonance spectrometer at Arizona State University. For more information contact Michael Wolfe, (202) 586-5462.

**University-Based Research**—In addition to its education programs, DOE funds research projects carried out on college and university campuses nationwide. These research programs provide valuable training for thousands of students each year, particularly graduate students, and help faculty members stay current in energy-related areas. In some cases, these research initiatives have explicit educational goals. For example, DOE's Office of Environmental Restoration and Waste Management (EM) has established three university partnerships: in New Mexico, in South Carolina, and another with predominantly minority colleges and universities (HBCUs). These partnerships involve university consortia linked to a DOE facility to encourage the preparation of students for careers in disciplines supportive of the EM mission. Another example of a research program with explicit educational objectives is the Office of Civilian Radioactive Waste Management's (RW's) research program for HBCUs. For more information on EM's programs contact Isiah Sewell at (301) 903-7643; for information about RW's programs, contact Ginger King at (202) 586-2835.

Similarly, the DOE Experimental Program to Stimulate Competitive Research (EPSCoR) is designed to enhance the capabilities of designated States to conduct nationally competitive energy-related research and to develop science and engineering manpower capabilities to meet current and future personnel needs. Eligibility for these awards is restricted to the State planning committees for the following: Alabama, Arkansas, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, North Dakota, Oklahoma, South Carolina, South Dakota, Vermont, West Virginia, Wyoming, and the

Commonwealth of Puerto Rico. For more information contact Donna Prokop, (202) 586-8910.

**Used Energy-Related Laboratory Equipment**—The Used Energy-Related Laboratory Equipment grant program makes available to colleges and universities laboratory equipment purchased by DOE for research but no longer needed by any departmental facilities or contractors. Examples of used equipment given to universities under this program range from power supplies, oscilloscopes, data recorders, amplifiers, and voltmeters to more sophisticated, special-purpose items, such as infusion pumps, bore scopes, and ion power-supply pumps. Available equipment is listed monthly in a catalog that is available through subscription from the U.S. Government Printing Office and in the FEDIX dial-up computer database. The program operates on a "first come and qualified" basis, with crating and shipping the only expenses the recipient incurs. Title to the equipment is vested in the recipient institution. For more information contact Larry Barker, (202) 586-8947.

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## Public Understanding of Science and Other Programs

DOE also supports programs designed to improve public understanding of energy-related scientific topics and to encourage more students to aspire to careers in technical fields. Some major initiatives in this area are summarized briefly in this section.

**"Breaking Through" Video**—This 30-minute human interest documentary inspires girls in junior and senior high school to pursue careers in science and technology. "Breaking Through" features the exciting lives of women from Sandia National Laboratories/California, Lawrence Livermore National Laboratory, and the NASA Jet Propulsion Laboratory at work, at home, and at play.

Debuting on public television, "Breaking Through" will be available for use by educators, interested organizations, and individuals. A shorter, 15-minute version is also being produced to provide additional flexibility depending on the age and attention span of the audience. For information on ordering see the Other DOE Related Materials section, page 145.

**Energy Environment Simulator**—The Energy Environment Simulator is a tool to enhance science curriculum by contributing to all levels of student and faculty understanding of science through the energy question. It is a mechanism to educate the public in science and energy. The Simulator is a computerized simulation of our energy resources, energy consumption, and environmental effects. It provides instantaneous readouts for each of the factors involved. The program places the participants in the position of having to come to grips with the energy problem. Funding is

"Breaking Through" inspires junior high and senior high girls to consider careers in science and technology through an exploration of the women working at DOE and NASA facilities.

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provided by the U.S. Department of Energy. The program is being developed and operated by the Associated Western Universities Northwest Division. For more information contact John Taber, (509) 375-3090.

**Environmental Restoration and Waste Management Education Programs**—The U.S. Department of Energy has a mandate to help ensure the availability of personnel to meet its needs in environmental protection as well as in hazardous-waste management. Projections show a growing need for scientists, engineers, and technicians for a variety of positions in these vital areas of work. Through the Office of Environmental Restoration and Waste Management and the Office of Civilian Radioactive Waste Management, DOE supports many education programs that are specifically designed to encourage students to prepare for these careers.

High school student Han Le participates in a research project at San Jose State University with scientist Robert Montoya as part of the Environmental Management Precollege Analytical Chemistry Program sponsored by DOE's Office of Environmental Restoration and Waste Management

Some programs, such as the Environmental Restoration and Waste Management Fellowship and the Civilian Radioactive Waste Management Fellowship, have been identified previously in this catalog. In addition, many of the programs listed in the Facility Descriptions section involve research experiences or other activities that build on DOE's environmental-restoration or waste-management programs. Other activities include workshops and teaching materials, such as the "Science, Society, and America's Nuclear Waste" curriculum for grades 8–12. Detailed information about workshops and other programs sponsored by the Office of Civilian Radioactive Waste Management can be obtained by calling Ginger King at (202) 586-2835.

The Waste Management Education and Research Consortium is another example of how DOE supports education in this area. The Consortium was created in 1990 as a partnership of New Mexico State University, the University of New Mexico, and the New Mexico Institute of Mining and Technology in collaboration with Los Alamos National Laboratory and Sandia National Laboratories. Its mission is to expand the Nation's capability to address issues related to the management of all forms of waste via education, technology development, and information transfer. Currently, more than 2,000 precollege students, college students, and professionals receive the education benefits, and more than 40 technology-development projects are supported under this initiative. Information on this and other programs sponsored by the Office of Environmental Restoration and Waste Management can be obtained by calling Isiah Sewell at (301) 903-7643.

**Formal Partnership Memoranda of Understanding**—Many of DOE's new mathematics and science education initiatives are carried out through partnerships with schools, businesses, museums, and other entities that can offer expertise and support. In addition, to broaden program outreach, the Department has established formal partnerships through agreements with other Federal agencies and with private-sector organizations. Most of these agreements will be implemented with the assistance of DOE's national laboratories.

The Department has signed memoranda of understanding directed at encouraging more students to pursue careers in science, mathematics, and engineering with the National Aeronautics and Space Administration, the Appalachian Regional Commission, the Department of Agriculture, the Department of the Interior, the Tennessee Valley Authority, the Department of Education, and the Environmental Protection Agency (EPA). In each case, DOE has sought to strengthen existing laboratory-based programs and to broaden the scope of the potential contributions that can be made by leveraging the laboratory resources. As an example of one partnership, DOE and EPA are collaborating on the SWOOPE precollege program (see page 17), which teaches children science and mathematics through observations of the environment.

The National Energy Research Supercomputer Center at Lawrence Livermore National Laboratory provides access to a supercomputer donated by the Cray Research Foundation for educational programs throughout the United States. This Cray X-MP, designated the National High School Supercomputer (see page 13), is being used as a learning tool by thousands of high school students and teachers. Access to the supercomputer strengthens educational partnerships between DOE laboratories and schools by providing an avenue for DOE professionals to work directly with educators on bridging the gap between textbook concepts and real-life applications.

Jaime Escalante, the well-known high school math teacher portrayed in the Academy Award-winning film "Stand and Deliver," is the host of FUTURES, an upbeat, fast-paced Public Broadcasting Service series focusing on the understanding and use of mathematical concepts.

DOE also signed a formal agreement with the Mid-Atlantic Coca-Cola Bottling Company, which will help make funds available for inner-city and rural students to participate in DOE summer programs at the national laboratories and to work with leading-edge technologies. The first student participant, from the District of Columbia, studied at Oak Ridge National Laboratory.

A partnership between DOE and the Cray Research Foundation supports the National Science Bowl® (see page 14). Regional competitions are conducted annually across the country at DOE and other facilities. Winning teams travel to Washington, D.C., for the national finals held in April. For more information contact Rich Stephens, (202) 586-8949.

**FUTURES**—FUTURES is a video series designed to stimulate student interest in mathematics. Classroom scenes with nationally renowned teacher Jaime Escalante introduce mathematical principles, such as ratios, fractions, velocity, and volume. Some videos include interviews with specialists in high-technology careers. They explain why studying mathematics is so important to preparing for future careers. FUTURES specials, which have been shown on public television, include "Math, Who Needs It?!" in 1992 and "Living and Working in Space" in 1993. The latter emphasizes that space-related jobs are not restricted to astronauts or scientists with graduate degrees. This special highlighted how people are needed in design, construction, transportation, management, health care, food production, and a wide range of other fields not generally associated with space exploration. DOE cosponsors the series with ARCO, IBM, McDonald's, the MacArthur Foundation, the National Science Foundation, and the Carnegie Corporation of New York. Nationwide, teacher workshops are conducted to demonstrate how the tapes can be used effectively in the classroom around the country and at some DOE facilities. For more information contact John Ortman, (202) 586-1634.

**Las Vegas JASON Project Science Consortium**—The JASON Project began as the dream of Robert Ballard, a Woods Hole Oceanographic Institution scientist. Dr. Ballard is best known for his discoveries of the *Titanic* and the German battleship *Bismark* shipwrecks. In a quest to motivate and excite students in science and technical careers, Ballard established the JASON Foundation for Education.

A unique partnership was formed with government, the local business community, and the School–Community Program, Clark County School District, called the Las Vegas JASON Project Science Consortium. The Consortium brings the JASON Project to approximately 30,000 students, transporting them from the desert to the oceans of the world via "telepresence." Through interactive science, JASON will capture students' imaginations and expand their understanding of science, mathematics, and relationships to other technologies. The JASON Project is affiliated with DOE's Nevada Test Site and Yucca Mountain Site Characterization Project. For more information contact Rudy Cruz, (702) 295-3521.

The Scholastic Productions television series "The Magic School Bus," which premieres in 1994, will feature Ms. Frizzle

**Magic School Bus**—Based on the popular children's books published by Scholastic, Inc., this Public Broadcasting Service series will premiere in 1994. "The Magic School Bus," a fully animated program produced by Scholastic Productions, is designed to motivate young children toward careers in scientific fields as they follow Ms. Frizzle, a teacher who takes her students on field trips filled with scientific adventure and mystery. In addition to the Department of Energy, other major contributors to the development of the series include the National Science Foundation (NSF) and the Carnegie Corporation of New York. DOE is actively involved in developing collaboration on informal museum education outreach initiatives with Scholastic Productions, the Association of Science Technology Centers, and others to promote the series. For more information contact Kasse Andrews-Weller, (202) 586-8949.

Public School 92 in New York City visits the Manhattan Children's Museum, where a Ms. Frizzle look-alike greets them to explore the ocean.

**Museum Science Education Program**—Since 1991, DOE's Museum Science Education Program has helped increase the public's understanding of science through energy-related exhibitions, programs, and media in science/technology centers, zoos, aquariums, and other museums. During 1991 and 1992, 19 institutions were funded through an annual appropriation of $1 million. Some recent recipients include the Lexington Children's Museum, New York Zoological Society/Bronx Zoo, South Dakota Discovery Center and Aquarium, SciTech in Aurora, Illinois, the Exploratorium in San Francisco, and the Discovery Center of Idaho. For more information call Kasse Andrews-Weller at (202) 586-8949 and ask for the proper forms or see the Document Request Form on page 149.

The Globehead Family stars in a claymation cartoon featured in the exhibition "Our Urban Environment" funded in part by DOE at the California Museum of Science and Industry in Los Angeles.

A student experiments with the Plasmasphere, one of more that 20 touch-and-do exhibits at the Brookhaven National Laboratory Science Museum.

**Museums and Science Centers**—The American Museum of Science and Energy, Oak Ridge, Tennessee; Bradbury Science Museum, Los Alamos, New Mexico; Brookhaven National Laboratory Science Museum, Upton, Long Island, New York; Leon M. Lederman Science Education Center, Batavia, Illinois; and National Atomic Museum, Albuquerque, New Mexico, are supported by DOE at or near the laboratory sites.

While some of these facilities have exhibits and collections centered on a specific topic, all of them are dedicated to the presentation of science with the aim of increasing visitors' awareness of advances in the understanding of the physical and life sciences; mathematics and computer sciences; environmental issues; and energy technologies, uses, and policies. Each achieves this increased awareness in a variety of ways, to include displays; models; interactive exhibits; lectures and demonstrations; historical collections; and the offering of educational programs, fairs, and student competitions.

**National Energy Information Center (NEIC)**—The NEIC serves as the primary point of contact for access to Energy Information Administration (EIA) data and publications. The staff answer general questions on energy and specific questions on energy data via telephone, by letter, or in person from State and local agencies, the academic community, industrial and commercial organizations, the news media, and the general public. The NEIC provides ordering information for EIA publications and machine-readable products, provides complimentary copies of blank data-collection forms, and operates a public reading room containing EIA publications. The NEIC can be reached at (202) 586-8800.

**NEWTON**—NEWTON is an international computer bulletin board system operated for teachers, students, and the general public by Argonne National Laboratory. NEWTON features "Ask A Scientist," in which Argonne scientists and others will post short answers to students' questions on various topics and provides teachers with the option to network with other teachers nationwide. The bulletin board can be reached by Internet, Telnet to newton.dep.anl.gov or by dial up at (708) 252-8241, 300-19200 Baud: N81. To log on to the system, type "cocotext" and then choose to enroll as a new user. Questions about NEWTON can be answered electronically by Telnet at help@newton.dep.anl.gov or by voice at (708) 252-6925. See the Other DOE Related Materials information on page 147.

**"Northwest Women in Science"**—Recognizing the need to include women in the educational programs of the U.S. Department of Energy and to encourage them to enter into and continue in further education in science and engineering, Associated Western Universities Northwest Division will update

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and reprint the current role model publication, "Northwest Women in Science." It will be disseminated in the Pacific Northwest—Alaska, Idaho, Montana, Oregon, and Washington. For more information contact John Taber, (509) 375-3090.

**OREN**—OREN (Oak Ridge Educational Network) is a wide-area computer network providing electronic communication capabilities for educational purposes. Funded by DOE and established by Oak Ridge National Laboratory (ORNL), OREN allows teachers, students, and other users access to the Internet network. Some of the many resources available through OREN are ERIC, the Library of Congress, NASA Spacelink, eMath, Internet Relay Chat, and Archie and Gopher/WAIS. To obtain more information on eligibility, contact ORNL's Office of Science Education and External Relations at (615) 576-9495 (electronic mail address: wou@ornl.gov). See the Other DOE Related Materials section, page 147.

Brandy Justice, an intern at Oak Ridge National Laboratory, demonstrates the Oak Ridge Educational Network for Maryland Congresswoman Constance R. Morella at the National Academy of Sciences in Washington, D.C.

**REACTS**—In 1990, several EG&G Energy Measurement employees founded a nonprofit organization called REACTS (Rediscovery Education Activities Create Tomorrow's Scientists). In association with DOE's Nevada Test Site, REACTS enlists volunteers to develop interesting and exciting science demonstrations and train others to perform the demonstrations for elementary and secondary school students in their classroom. A typical REACTS demonstration has preschoolers laughing and yelling excitedly as a black pile of ammonium dichromate burns and spurts red-hot ash like a molten volcano.

REACTS volunteers visit as many Santa Barbara, California, area schools as possible, working toward the goal of building a sturdy foundation in the community and expanding the program throughout California.

**School Partnership Programs**—As part of the President's National Partnerships in Education Program, DOE, its field offices, and laboratories have formed partnerships with more than 150 local elementary and secondary schools. A few of the many examples are the Nevada Test Site and schools in surrounding counties, Oak Ridge National Laboratory and the science departments of six local high schools, the Western Area Power Administration and Skinner Middle School in Denver, and the Morgantown Energy Technology Center and the Monongahela School District Education Alliance in West Virginia. The entire Atlanta Public School System has entered in partnership with DOE's Atlanta Support Office. The Marty Indian School in Marty, South Dakota, has DOE's pledge to implement science and math education programs and to assist in the school's expansion and upgrade of its computer resources. Computer assistance was provided by Chicago Field Office, Kansas City Support Office, and Princeton Plasma Physics Laboratory as well as Computer Data Systems, Inc.

The Pantex Plant provides employees the opportunity to go to the schools and supplement the regular teachers' instruction with guest lectures. In the 1992–93 year, about 20 employees made presentations to 28 schools. This involves about 1,100 students and a total of about 225 presentations during the school year. The presentations include the following topics: light and optics, scientific research, fossils, photography, animation, aviation, pulleys, lasers, computers, engineering and design, and robotics.

Adopted or partnership schools receive loaned equipment and materials, career counseling and tutoring, field trips to scientific facilities, help with science fair projects and judging, and other forms of support. For more information contact Rich Stephens, (202) 586-8949.

Western Area Power Administration's Join-A-School Program is an example of a School Partnership Program where staff members volunteer as tutors for students.

**Science and Technology Education Program (STEP)**—Established in 1990 at the Nevada Test Site, the Science and Technology Education Program (STEP) addresses the critical shortage of trained personnel available for Environmental Restoration (ER) and Waste Management (WM) careers by funding development of educational programs in ERWM areas and in mathematics and science enhancement activities. For information about STEP activities, contact Rudy Cruz at (702) 295-3521. Among the programs funded the past three years are the following:

Introduction to Technology (1990) is a pilot project that motivates student interest in mathematics and science. The course includes biotechnology, robotics, information/communication technology, and physical technology. Students apply their new understanding of technology to problem solving and to the design, development, maintenance, and operation of systems in each technology studied. The technology classroom concept was so successful, the State legislature mandated the program to be taught to all Nevada students before completing the 8th grade.

Project SUMS (Students Understanding Mathematics and Science) (1991) involved 30 students and 30 teachers who participated together in workshops encouraging students from underrepresented groups to participate in mathematics and science education. The workshops utilize a problem-solving approach and modeling concept. Teachers are able to try new instructional methods and see the students' immediate response and adopt SUMS methods for the classroom.

University of Nevada at Las Vegas (UNLV) Environmental Studies Program (1991) was funded by STEP to fund a distinguished lecture series to improve public science literacy, generate undergraduate interest for environmental studies, and curriculum development. The program received commitments from 65 undergraduates who want to major in environmental studies in the 1992–93 school year.

Community College of Southern Nevada (CCSN) Environmental Restoration Technology Program (1991) also used funds from STEP to start an Environmental Restoration Technology (ERT) program at the community college. A community outreach component was funded to help increase interest in this emerging field among women and minorities. The ERT program has enrolled over 100 students in the first year of operation and expects to receive State approval as a degree-granting program in 1992–93.

**Science Volunteers Programs**—All DOE research facilities provide the services of their technical staff to academic institutions in their areas. Time is volunteered in support of visiting-scientist programs, mentoring activities, special seminars, science fairs, and a variety of other activities. These activities are all designed to encourage the use of laboratory expertise to enhance the educational programs of participating schools. Each year, thousands of DOE-supported scientists serve as volunteers through these programs.

**"Space Age"**—"Space Age" is a PBS series designed to provide teachers and students with the latest developments from the frontiers of space research. The PBS program was funded through DOE's Office of Space Research in cooperation with WQED/Pittsburgh National Media Outreach Center and NHK/Japan and is developed in cooperation with the National Academy of Sciences.

**"The New Explorers with Bill Kurtis" and Chicago Science Explorers Program**—"The New Explorers with Bill Kurtis" is a series of many videos designed to motivate students toward careers in science. The key to this motivation is the way the program highlights the personalities and interests of scientists at work. They are portrayed as pioneers on the cutting edge of discovery.

working in a variety of research settings. The videotapes are aired at scheduled times on Public Broadcasting Service stations. In the classroom, the series can be enhanced by educational materials designed to motivate students toward careers in science. The development of these instructional materials and workshops has been supported by the Department of Energy's Argonne National Laboratory and the Chicago Science Explorers Program. (See New Explorers Partners, page 16.) Others contributing to the development of the program are the Amoco Corporation, Waste Management, Inc., and Duracell. More information about the video series and teacher's guides can be obtained by calling (800) 621-0660.

Sandy Kravitz of Kurtis Productions gives Maria Gonzales, Development Coordinator of the Mexican Fine Arts Museum, one of "The New Explorers with Bill Kurtis" posters.

**Other Programs**—In addition to the preceding programs, DOE facilities and field offices conduct a number of ongoing formal and informal programs, including research opportunities for students and teachers; workshops and institutes; supplemental materials development; in-house tours, lectures, and demonstrations; direct classroom instruction; support of such special events as National Chemistry Day, Earth Day, and National Science and Technology Week; judging of science fairs; mentoring students and teachers; community outreach; and a variety of special events. For example, Fermi National Accelerator Laboratory offers a Saturday Morning Physics lecture series for high school students and a workshop on particle physics for junior high and middle school teachers. The Continuous Electron Beam Accelerator Facility conducts a monthly science series that brings 200 to 300 students from grades 6–12 together for a participatory evening seminar and informal discussions with community scientists and engineers. Pacific Northwest Laboratory provides a Sharing Science with Schools program for junior and senior high schools. Numerous DOE offices are also involved in outreach, for example:

- The Albuquerque Field Office conducts a successful mentoring and tutoring program in the Albuquerque public schools and on neighboring Indian reservations.
- The Amarillo Site Office through its Pantex facility supports a variety of programs, including the "Voyage of the *Mimi*," a full-year, multimedia science program based on the experiences of the *Mimi*, a research vessel used to locate and study whales.
- The Atlanta Support Office has a partnership agreement with the entire Atlanta Public School System and supports several special university consortia that enhance campus-based research and education programs.
- The Boston Area Office has developed and distributes a guide to energy-related instructional materials.
- The Kansas City Support Office, along with many other projects, works with the Wonderscope Children's Museum in Shawnee, Kansas, on the development and expansion of energy and environmental displays and programs.

Student programs seek to stimulate student interest in science careers and improve general scientific literacy. Teacher programs aim to build content knowledge; improve instructional strategies; increase career awareness; improve understanding of relationships among science, technology, and society; and improve supplemental materials.

Jason Hisle, Jackie Hisle, and Danny Oberhelman explore the Journey into a Landfill exhibit at the Wonderscope Children's Museum in Shawnee, Kansas, supported by DOE's Kansas City Support Office.

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## Summary

Education programs sponsored by DOE take many forms. Some are targeted at precollege students to encourage them to take the courses needed to prepare them to continue studying in technical fields. Other programs are designed to enhance the education programs offered on college and university campuses. These programs benefit undergraduates, graduate students, and faculty in ways that encourage study in fields supportive of DOE's overall mission. Still other DOE programs promote the public understanding of science. All are designed to encourage full participation in science by all members of society, including women, minorities, and persons with disabilities.

Information for some of these activities can be obtained from the U.S. Department of Energy program offices that sponsor them. Figure 7 gives a list of DOE offices that support education programs. Appropriate contacts are given for each office.

Many of these activities are supported by the Department's large network of laboratories, research centers, and other facilities. Figure 8 shows the specific facilities that host certain national programs funded by DOE. Each of these also sponsors programs that are unique to the site. A listing of these site-specific programs is given in the Facility Descriptions section of this catalog. Detailed information about the full range of activities at each laboratory or facility can be obtained by contacting the educational program contact at the phone number provided. In addition, please refer to the resources for information for ordering education materials and other documents provided at the back of this catalog.

## Department of Energy

### Office of Science Education and Technical Information

**Office of University and Science Education Programs**
1000 Independence Avenue SW
ET-3
Washington, DC 20585
phone (202) 586-8949
fax (202) 586-0019

Richard Stephens
*Director*

Melissa Murray
*Deputy Director*

**Undergraduate/Graduate Programs**
Larry Barker
Robyne Gordon
Bernie Hite
Donna Prokop
Michael Wolfe

**Precollege Programs**
Kassie Andrews Weller
Cindy Musick
John Ortman
Gail Pritchard
Warren Richard
Sue Ellen Walbridge

**Program Evaluation**
Marge Dwyer

**Regional Education Coordinators**

Betsy Schaben Palmer
Atlanta Area Field Office
U.S. Department of Energy
730 Peachtree Street, Suite 876
Atlanta, GA 30308
(404) 347-3088

James Evans
National Renewable Energy Laboratory
1617 Cole Blvd.
Bldg. 17, Rm. 32
Golden, CO 80401
(303) 231-1935

Lani MacRae
Western Area Power Administration
U.S. Department of Energy
Sacramento Area Office
1825 Bell Street
Sacramento, CA 95825-1097
(916) 649-4436

## DOE Program Offices and Other

*Additional information about specific programs can be obtained by contacting the following individuals*

**Bonneville Power Administration**
Rita Owen (503) 231-6860

**Office of Civilian Radioactive Waste Management**
Ginger King (202) 586-2835

**Office of Energy Efficiency and Renewable Energy**
- *Energy and Diagnostic Centers*
  Chuck Glaser (202) 586-1298
- *SunRayce and Junior Solar Sprint*
  Richard King (202) 586-1693
- *Other Vehicle Competitions*
  Phil Patterson (202) 586-9121

**Office of Defense Programs**
Maurice Katz (202) 586-5799

**Office of Environment, Safety and Health**
Lynne Fairobent (202) 586-6151

**Office of Environmental Restoration and Waste Management**
Isiah Sewell (301) 903-7643

**Office of Fossil Energy**
Robert Porter (202) 586-6503

**Office of Fusion Energy (ER)**
Don Priester (301) 903-3421

**Office of Health and Environmental Research (ER)**
Murray Schulman (301) 903-3338

**Office of Economic Impact and Diversity**
Annie Whatley (202) 586-1593

**Office of Nuclear Energy**
Phil Garon (202) 586-6823

**Western Area Power Administration**
Jack Dodd (202) 586-5581

Figure 7. DOE Contacts for Information on Education Programs

# FACILITY DESCRIPTIONS

This section provides brief descriptions of the U.S. Department of Energy national laboratories, technology centers, and other facilities that sponsor or host DOE education programs. Descriptions appear in alphabetical order and contain tables that list specific programs offered at each site. With these tables, it is possible to quickly identify activities that serve a particular audience or target group. Some general information is given for each program to help determine which programs are likely to be the most beneficial to an individual. For more detailed information, educational program contacts are listed for each facility. These persons are responsible for the overall operation of programs at their respective sites and will provide information or refer calls to the appropriate program manager.

The U.S. Department of Energy supports more than 800 education programs at its facilities. Each year, individuals from throughout the world participate in these programmatic activities that are designed to make available the extensive resources of DOE's network in support of the national education goals. See the Federal Science, Mathematics, Engineering, and Technology Education Strategic Planning Framework and Priority Framework on pages 6 and 7. Precollege students and teachers, community college and university faculty, postdoctoral candidates, and the general public benefit from these programs. Science, mathematics, engineering, and technology education are significantly enhanced through these efforts. The result is improved understanding and increased interest in energy-related issues and careers.

In using this section, note that program names used at a particular site may differ somewhat from the more generic titles used in Figure 8 and in the Program Descriptions section in this catalog.

| HOST LABORATORY OR FACILITY | Designated Scientific User Facilities | Earth Day Poster Contest | Faculty Research Participation | FCCSET Fellows Laboratory<br>Faculty Training Program | Graduate Student Research Participation | Graduate Student Thesis Research | High School Science Student Honors | High School Student Research Apprenticeship | National Science Bowl[1] | School Partnership Program | Science and Engineering Research Semester | Teacher Research Associates | Undergraduate Student Research Participation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ames Laboratory | X | | X | | X | X | | | X | X | | X | X |
| Argonne National Laboratory | X | X | X | X | X | X | X | X | X | X | X | X | |
| Associated Western Universities[2] | | | X | | X | X | | | X | | | X | X |
| Associated Western Universities Northwest Division[2] | | | X | | X | X | | | X | | | | X |
| Bates Linear Accelerator Center | X | | X | | X | X | | | X | | | X | |
| Bonneville Power Administration | | X | | | | | | | X | | | | |
| Brookhaven National Laboratory | X | X | X | | X | X | X | X | X | X | X | X | X |
| Continuous Electron Beam Accelerator Facility | | | X | X | X | X | | | X | X | | X | X |
| Fermi National Accelerator Laboratory | X | X | X | | X | X | X | X | | X | | X | X |
| Fernald Environmental Management Project | | X | | | | | | | X | | | X | |
| Idaho National Engineering Laboratory | X | | X | | X | X | | | X | X | | X | X |
| Inhalation Toxicology Research Institute | | | X | | X | X | | | | | | X | X |
| Kansas City Area Office | | | | | | | | | X | X | | | |
| Lawrence Berkeley Laboratory | X | X | X | X | | X | X | | X | X | X | X | X |
| Lawrence Livermore National Laboratory | X | | X | | X | X | X | | X | X | X | X | X |
| Los Alamos National Laboratory | X | X | X | | X | X | | | X | X | X | X | X |
| Morgantown Energy Technology Center | | | X | | X | X | | | X | X | | X | X |
| Mound Facility | | X | X | | X | X | | | X | X | | X | X |
| National Renewable Energy Laboratory | | X | X | | X | X | | | X | X | | X | X |
| Naval Petroleum Reserves in California | | X | | | | | | | X | | | | |
| Nevada Test Site | X | X | X | | X | | | | X | X | | X | |
| Oak Ridge Institute for Science and Education[2] | | X | X | X | X | X | | | X | X | | X | X |
| Oak Ridge National Laboratory | X | X | X | | X | X | X | | X | X | X | X | X |
| Pacific Northwest Laboratory | X | | X | X | X | X | | X | | X | X | X | X |
| Pantex Plant | | X | | | | | | | X | | | | |
| Pittsburgh Energy Technology Center | X | X | X | | X | X | | | X | X | | X | X |
| Princeton Plasma Physics Laboratory | | X | | | X | X | | | X | X | | X | X |
| Rocky Flats Plant | | | | | | | | | X | X | | X | |
| Sandia National Laboratories/California | X | | X | X | X | X | | | X | X | | X | X |
| Sandia National Laboratories/New Mexico | X | | X | X | X | X | X | | X | X | | X | X |
| Savannah River Ecology Laboratory | | | X | | X | X | X | | | X | | X | X |
| Savannah River Technology Center | | X | X | | X | X | X | | X | | | | X |
| Stanford Linear Accelerator Center | X | | | | | X | | | | X | | X | |
| Strategic Petroleum Reserve | | X | | | | | | | X | X | | | |
| Western Area Power Administration | | | | | | | | | X | X | | | |
| Westinghouse Hanford Company | | | X | | X | | | | | X | | X | X |
| Yucca Mountain Site Characterization Project | | | | | | | | | X | | | X | |

**Notes:**
Only those facilities hosting specified national programs are represented in this table. In some cases program names used at a particular site differ from the generic titles used here. Information about these and additional programs offered by DOE facilities is given in the Facility Descriptions section of this catalog.

[1] In addition to the facilities shown above, the National Science Bowl® will have regional competitions through the DOE Nevada Test Site in Las Vegas, Nevada, the DOE Pantex Plant in Amarillo, Texas, DOE Pinellas Area Office in Largo, Florida, Western Area Power Administration (WAPA) in Loveland, Colorado, and Strategic Petroleum Reserve in Sacramento, California.

[2] These facilities serve as administrative support organizations for many DOE education programs.

Figure 8. National DOE Education Programs by Host Facility

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## AMES LABORATORY

**Ames, Iowa**

Operated by Iowa State University

Ames Laboratory (Ames) conducts basic research in physical, chemical, materials, mathematical, and engineering sciences. Ames performs related studies in materials synthesis and processing, materials reliability, and nondestructive evaluation. This fundamental research program is maintained to provide solutions to energy-production and -use problems in the medium- to long-term regimes and to address other problems of national importance.

Primary program areas at Ames are basic energy sciences, fossil energy, high-energy physics, nuclear physics, environmental sciences, environmental restoration and waste management, nuclear-energy research, and nuclear safeguards and security. Extensive interaction with Iowa State University is achieved through faculty appointments, graduate student training, science education, facility sharing, and technology-transfer programs.

**DESIGNATED SCIENTIFIC USER FACILITIES**
Coal Preparation and Characterization Facility
Materials Preparation Center

**EDUCATIONAL PROGRAM CONTACT**
Connie Hargrave
Educational Coordinator
108 Office and Laboratory Building
Ames Laboratory
Iowa State University
Ames, IA 50011
(515) 294-9682

Under the watchful eye of Bob Furnio, elementary school teachers Elaine Pauly, Ann Skellenger, and Roberta Varisco test the acidity of various household products as part of the National Geographic KidsNetwork summer institute held at Ames Laboratory.

## AMES LABORATORY

| | Audience[1] | Page Description in Catalog | Typical Duration in Days (d), Months (m) or Years (y) | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | Annual Participation | Geographical Focus of Program |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adventures in Supercomputing | T (9-12) | | 1 m | X | x | X | x | X | x | X | 15 | IA |
| Challenges for Youth—Talented and Gifted Program | S (K-12) | | 1 d | | x | X | | X | | | 100 | IA |
| Environmental Chemistry | S (7-10) | | 1 m | X | | X | | X | | | 20 | National |
| Friends of Ames Lab | S, T (K-8) | | | X | x | X | x | X | | | 300 | IA |
| Improving Success in Calculus | T (9-12) | | 9 m | | x | X | x | X | x | X | 15 | IA |
| Middle School Math and Science Program | S (5-8) | | 1 m | X | x | X | x | | | | 30 | IA |
| National Geographic KidsNetwork | T (3-7) | 14 | 5 d | X | | X | x | X | x | | 21 | IA |
| National Science Bowl® | S (9-12) | 14 | 1 d | | x | | x | X | | | 200 | IA |
| Problem Solving Through Innovative Thinking | S (9-12) | | 1 m | X | | X | x | X | | | 20 | IA |
| Science Bound | S, T (8-10) | | 4 y | X | x | X | x | X | x | | 70 | IA |
| SuperKids | S (7-8) | | 8 d | | x | X | | X | | | 40 | IA |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | | X | | X | x | | 7 | National |
| Twentieth-Century Physics | S (7-9) | | 1 m | X | | X | | X | | | 20 | IA |
| Ames Lab/College of Education Instructional Computing Lab | U, G | | 1 d | X | x | X | | | | | 1500 | IA |
| Ames Student Trainees | U | | 2 m | X | | X | | X | x | | 30 | National |
| Faculty Associates | F | | 2 m | X | | X | x | X | | | 1 | National |
| Faculty Research Participation | F | 35 | 3 m | X | | X | | X | x | | 175 | IA |
| Graduate Fellowships—Computational Science Fellowship Program | G | 35 | 4 y | | | | x | | x | | 50 | National |
| Graduate Student Associates | G | | 1 y | X | x | X | | X | | | 65 | National |
| Graduate Student Research Participation | G | 35 | 5 y | X | x | X | | X | x | | 300 | National |
| Graduate Student Thesis Research | G | 35 | 2 y | X | x | X | | X | | | 300 | IA |
| Joint Appointments for Iowa State University Faculty | F | | Varies | X | x | X | x | X | | | 70 | IA |
| Postdoctoral Appointments | P | | 2 y | X | x | X | | X | x | | 75 | National |
| Ames Lab Tours | General | | 1 d | X | x | X | | X | | | 400 | IA |
| Ames Lab VEISHEA Exhibit | General | | 1 d | | x | X | | X | | | 1000 | IA |
| Iowa State Fair Exhibit | General | | 10 d | X | | | x | X | | | 1000 | IA |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## ARGONNE NATIONAL LABORATORY

**Argonne, Illinois**

Operated by the University of Chicago

Argonne National Laboratory (ANL) conducts applied research and engineering-based development in nuclear fission and other energy technologies and scientific research in basic physical and life sciences. Research and development at ANL links technology-based research with engineering development from concepts to applications. Primary research and development program areas at ANL are nuclear energy, basic energy sciences, conservation and renewable energy, biological and environmental research, and superconductivity.

**DESIGNATED SCIENTIFIC USER FACILITIES**

- 4-MV Dynamitron Facility
- Advanced Photon Source (under construction)
- Argonne Tandem Linac Accelerator Facility
- Biological-Materials Growth Facility
- Facility for High-Resolution Atomic Spectroscopy
- High-Voltage Electron Microscope Tandem Facility
- Intense Pulsed Neutron Source
- JANUS Biomedical Research Reactor
- Users Support Center

**EDUCATIONAL PROGRAM CONTACT**

Sam Bowen, Acting Director
Division of Educational Programs
Argonne National Laboratory
9700 South Cass Avenue, Bldg. 223
Argonne, IL 60439
(708) 252-3374

Students on a field trip to Argonne fill out registration blanks for their radiation monitoring badges for their New Explorers experience.

## ARGONNE NATIONAL LABORATORY

| | Audience[1] | Page Description is Continued | Time Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Staff Involvement | Participant Stipends Available[3] | Instructional Materials Developed | Annual Participation | Geographical Focus of Program (Regional, State or City) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Access 2000 | S, T, U | | | X | X | | X | X | | | 300 | IL |
| Argonne Community of Teachers (ACT) | T | | 20 d | | X | X | | X | | X | 1200 | IL |
| Earth Day Poster Contest | S, T (K-8) | 10 | 1 d | | X | X | X | | | X | 300 | IL |
| Environmental Restoration | T (6-12) | | 5 w | X | X | X | X | X | X | | 60 | IL |
| Expanding Your Horizons Conference | S, T | | 1 d | | X | | X | X | | | 275 | IL |
| Explorer Post | S (10-12) | | 15 d | | X | X | | X | | | 150 | IL |
| High School Science Student Honors Program | S (11-12) | 11 | 14 d | X | | X | | X | X | X | 60 | National |
| High School Scientific Instrumentation Program | S (11) | | 5 d | X | | X | | X | | | 70 | IL |
| High School Student Research Apprenticeship Program | S (10) | 12 | 15 d | X | | X | | X | X | | 10 | IL |
| High School Student Research Participation | S (12) | | 2 m | X | | X | | X | X | | 25 | IL |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | X | | X | | | 400 | IL |
| New Explorers Partners | T (3-12) | 16 | 3 d | X | X | X | X | X | X | | Varies | National |
| Regional Instrumentation Sharing Program | S, T (6-12) | | | | | | | | | | 100 | |
| Science Matters Seminar | T, U, G, F, P | | 6w | | X | | | | | | 20 | IL |
| Teacher Institutes and In-Service Programs | T (6-8) | | 2-4 d | X | X | X | | X | X | | 100 | IL |
| Teacher Research Associates (TRAC) Program | T (9-12) | 16 | 2 m | X | | X | | X | X | | 65 | National |
| What Works in K-8 Science Education (Biennual) | T (K-8) | | 2 d | | X | | X | | | | 325 | Midwest states |
| [illegible] | | | | | | | | | | | | |
| Co-Op Program | U, G | | 24 m | X | X | X | | X | X | X | 140 | National |
| Faculty Research Leave Appointments | F | | 6 m | X | X | X | | X | X | | 12 | National |
| Faculty Research Participation | F | [illegible] | 2.5 m | X | | X | | X | X | | 65 | National |
| Graduate School Fair in Science and Engineering | U | | 1 d | | X | X | | X | | | 700 | Midwest states |
| Graduate Student Thesis Research | G | [illegible] | 5 y | X | X | X | | X | X | | 87 | National |
| International Student Exchange Program | G | | 3 m | X | | X | | X | X | | 10 | National |
| National Center for Parallel Computing Instruction | U, G, F | | 5 d | X | X | X | X | X | X | | 50 | National |
| National Science Foundation Teacher Institute | T | | 15 d | X | X | X | | X | X | X | 40 | IL |
| Regional Instrumentation Sharing Program | S, T, U, G, F | | 5 d | X | X | X | | X | | | 500 | Midwest states |
| Science and Engineering Research Semester (SERS) | U | [illegible] | 4 m | | X | X | | X | X | | 150 | National |
| Symposium for Undergraduates in Science, Engineering and Mathematics | U | | 2 d | | X | X | | X | | | 250 | Midwest states |
| Undergraduate Student Research Participation (SRP) | U | [illegible] | 2.5 m | X | | X | | X | X | | 200 | National |
| Workshops and Conferences | S, T, U, G, F | | 2-3 d | | X | X | | X | | | 1500 | National |
| [illegible] | | | | | | | | | | | | |
| Conference: Science Careers in Search of Women | S (6-12) | | 1 d | | X | X | | X | | | 350 | IL |
| NEWTON | General | 44 | | X | X | | | X | | X | 3000 | National |
| The New Explorers with Bill Kurtis and Chicago Science Explorers Program | S, T (4-12) | 47 | 10 d | | X | X | X | X | | X | 28000 | IL |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

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[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## ASSOCIATED WESTERN UNIVERSITIES

**Salt Lake City, Utah**

Operated by the Associated Western Universities, Inc.

The Associated Western Universities (AWU) is a consortium of 45 colleges and universities located primarily in the western United States. As a contractor to the U.S. Department of Energy (DOE), AWU coordinates a variety of regional and national science education programs that provide opportunities for precollege students, university students, university faculty, and recent university graduates to participate in research at more than 40 DOE-supported facilities across the United States. These cooperating facilities, which often supplement the funding AWU receives from DOE's Office of University and Science Education and Office of Environmental Restoration and Waste Management, include not only the multipurpose national laboratories but also smaller dedicated facilities, such as the Inhalation Toxicology Research Institute, the Laboratory of Biomedical and Environmental Sciences at UCLA, the Stanford Linear Accelerator Center, and the National Renewable Energy Laboratory.

**EDUCATIONAL PROGRAM CONTACT**
Thomas Squires
Associated Western Universities, Inc.
4190 South Highland Drive, Suite 211
Salt Lake City, UT 84124
(801) 273-8916

Teacher Research Associates (TRAC) Program participant Clemontene Rountree (left) discusses her findings with Lawrence Berkeley Laboratory (LBL) scientist Jill Havier. The TRAC Program is administered by the Associated Western Universities (AWU) consortium.

## ASSOCIATED WESTERN UNIVERSITIES

| | Audience[1] | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Staff Involvement | Participants Receive Stipends[3] | Instructional Materials Available | Annual Participation | Geographic Focus of Program (Principal State or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **[illegible]** | | | | | | | | | | | | |
| Environmental Management Precollege Analytical Chemistry (EMPAC) Program | S (10-11), T, F | | 1.5-2 m | X | X | | X | | X | | 280 | |
| International Science and Engineering Fair Special Awards | S, T | 12 | 7 d | X | | X | X | X | X | | 20 | National |
| National Science Bowl® | S (9-12) | 14 | 3 d | | X | X | X | X | X | | 270 | National |
| National Science Bowl® Awards | S (9-12), T (9-12) | | 14 d | X | | | X | | X | | 24 | National |
| Precollege Faculty Fellowships | T (1-12) | | 1-12 m | X | X | X | X | | X | | 30 | National |
| Preservice Science Education Fellowships | T | | 2 m | X | X | X | X | | X | | 5 | National |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | X | X | X | X | X | X | (400)[4] | National |
| **[illegible]** | | | | | | | | | | | | |
| Environmental Management Career Opportunities for Minorities (EMCOM) Program | U, G, F | | 3 y | X | X | X | X | X | X | | 80 | |
| Environmental Management Career Opportunities Research Experience (EMCORE) Program | U, G, F | | 3 y | X | X | X | X | X | X | | 66 | National |
| Faculty Research Participation | F | 35 | 2 m | X | X | X | | X | X | | 70 | National |
| Faculty Travel Grant Program | F | | 10 d | X | X | X | | X | X | | 15 | National |
| Graduate Cooperative Fellowship Program | G | | 3 y | X | X | X | X | X | X | | 5 | National |
| Graduate Student Thesis Research | G | 38 | 6 m | X | X | X | | X | X | | 45 | National |
| Idaho National Engineering Laboratory Historically Black Colleges and Universities (HBCU) Program | U, F | | 12 m | X | X | X | | X | X | | 10 | National |
| Laboratory Graduate Fellowship Program | G | | 3 y | X | X | X | | X | X | | 50 | National |
| Minority Access to Energy-Related Research Careers (MAERC) | U, F | 30 | 2 y | X | X | X | X | X | X | | 45 | |
| Postgraduate Fellowship Program | P | | 3 y | X | X | X | | X | X | | 50 | National |
| Professional Undergraduate Internship Program | U | | 9 m | X | X | X | | X | X | | 10 | National |
| Undergraduate Student Research Participation (SRP) | U | [illegible] | 12 m | X | X | X | | X | X | | 300 | National |
| **[illegible]** | | | | | | | | | | | | |
| Scholars in Residence | T, F | | 6-12 m | X | X | X | X | X | X | | 3 | National |
| Scientist/Engineer Distinguished Lecture Program | U, G, F | | 15 d | X | X | | X | X | X | | 5000 | |
| Seminars, Workshops, Institutes | F | | 14 d | X | X | X | X | | X | | 30 | National |

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[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

[4] Associated Western Universities administers this program at approximately 25 DOE laboratories/facilities.

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## ASSOCIATED WESTERN UNIVERSITIES NORTHWEST DIVISION

**Richland, Washington**

Operated by Associated Western Universities Northwest Division

Associated Western Universities Northwest Division is an association of 59 schools in Alaska, Idaho, Montana, Oregon, and Washington. Associated Western Universities Northwest Division conducts appointment programs in science and engineering and works cooperatively with DOE contractor laboratories in the Richland area.

Associated Western Universities Northwest Division programs include undergraduate research participation, graduate student research, and faculty research appointments in chemistry, mathematics, metallurgy, physics, computer science, engineering (nuclear, mathematical, chemical, and electrical), biology, radiobiology, environmental science, and alternative energy studies.

**EDUCATIONAL PROGRAM CONTACT**
John Taber
Associated Western Universities Northwest Division
100 Sprout Road
Richland, WA 99352-1643
(509) 375-3090

Graduate students participating in DOE's Graduate Student Research Participation program, administered by Associated Western Universities Northwest Division, conduct research on coyote populations at the National Energy Research Park.

## ASSOCIATED WESTERN UNIVERSITIES NORTHWEST DIVISION

| | Audience[1] | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Staff Involvement | Participants Receive Stipends[3] | Instructional Materials Available | Annual Participation | Geographical Focus of Programs (National, State or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| How Math Counts | S, T | | 3 d | | X | | X | X | X | | 200 | WA |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | | X | X | | | 200 | MT, OR, WA |
| Native American Teacher and Student Visits | S, U, G, F, T | | 2 d | | X | X | X | X | X | | 15 | AK, MT, OR, WA |
| Precollege Faculty Interaction with Pacific Northwest Laboratory (PNL) | T (8-12) | | 8 w | X | | | | X | X | | 112 | National |
| Precollege Student Research Participation at Pacific Northwest Laboratory and Westinghouse Hanford | S (8-12) | | 8 w | X | | | | X | X | | 38 | WA |
| **UNDERGRADUATE AND GRADUATE** | | | | | | | | | | | | |
| Faculty Research Participation | F | 35 | 3 m | X | X | X | X | X | X | | 209 | National |
| Graduate Student Thesis Research | G | 35 | 7 m | X | X | X | X | X | X | | 77 | National |
| Graduate/Postdoctoral Research Participation | G, P | | 12 m | X | X | X | | X | X | | 38/75 | National |
| Native American and Hispanic Program | U, G, F | | 12 m | X | X | X | X | X | X | | 50 | National |
| Non-Funded Appointments | U, G, F, P, S, T | | 10 w-1 y | X | X | X | X | X | | | 25 | National |
| Research Travel | U, G, F | | 3 d | X | X | X | X | X | X | | 5 | National |
| Science and Engineering Research Semester (SERS) | U | 35 | 16 w | X | X | X | X | X | X | | 108 | National |
| Seminars, Workshops, and Institutes | U, G, P, F | | 2 d | X | X | X | X | X | X | | 45 | WA |
| Undergraduate Student Research Participation (SRP) | U | 35 | 10 w | X | X | X | X | X | X | | 208 | National |
| Visitors Program | T, G, F, P | | 2 d | X | X | X | X | X | X | | 18 | National |
| **[illegible] SCIENCE AND OTHER** | | | | | | | | | | | | |
| Energy Environment Simulator Program | S, T, U, G, F, P | 35 | 1 d | X | X | X | X | X | | | 300 | National |
| Information Exchange Program | U, G, F | | 1 d | X | X | X | X | X | | | | National |
| Northwest Women in Science[4] | S, T (K-12), U | 44 | | | | | | | | | | AK, ID, MT, OR, WA |

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[4] Associated Western Universities Northwest Division developed the "Northwest Women in Science" publication as a role model guidebook and resource directory to be used by students, teachers, and parents. This will be updated in FY 1984.

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# BATES LINEAR ACCELERATOR CENTER

**Middleton, Massachusetts**

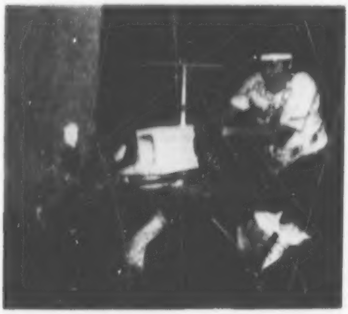
Operated by Massachusetts Institute of Technology

The William H. Bates Linear Accelerator Center, which is operated by the Massachusetts Institute of Technology for DOE, has two primary objectives: (1) the production of experimental data in medium-energy nuclear physics and (2) the education of highly trained scientists for employment at universities, DOE laboratories, and industry.

A high-intensity, high-resolution electron beam (1 GeV) is used to study nuclear properties. Programs are currently under way to measure charge, current, and magnetization distributions; photoreactions; coincidence reactions; and polarized-beam interactions.

About 200 participants from more than 50 institutions are active in the research program. The center has produced 5 to 10 percent of the Nation's doctorates in nuclear physics during the past few years.

**EDUCATIONAL PROGRAM CONTACT**
William Lobar
Bates Linear Accelerator Center/MIT
P.O. Box 846
Middleton, MA 01949
(617) 245-6600



During a Massachusetts Institute of Technology Independent Activities Period, Physics teacher Stan Rzepecki makes a point about momentum and energy conservation by lying on a bed of nails while his student, Derek Garvey, crushes a concrete block with a sledgehammer. Rzepecki survived to participate in the Bates Nuclear and Particle Physics for High School Teachers program and the Teacher Research Associates (TRAC) Program.

## BATES LINEAR ACCELERATOR CENTER

| | Audience* | Page Description in Catalog | Typical Duration in Days (d) Weeks (w) Months (m) Years (y) | Summer Activities | Academic Year Activities | On-Site Activities† | Off-Site Activities† | Direct Staff Involvement | Participants Receive Stipends‡ | Instructional Materials Available | Annual Participation | Geographical Focus of Program (Principal State or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bates Early Education Program (BEEP) | S (8) | | 8 m | | X | X | X | X | | | 240 | MA |
| Boston University's Young Scholars Program (Interns—Research Participation) | S (9-12) | | 6 w | X | | X | X | X | X | | 2 | National |
| Hamilton-Wenham Regional High School (Interns—Technical Participation) | S (9-12) | | 4 m | | X | X | | X | | | 2 | MA |
| Nuclear and Particle Physics for High School Teachers | T (9-12) | 10 | 1 y | X | X | X | | X | X | | 24 | MA |
| Teacher Research Associates (TRAC) Program | T (7-12) | 10 | 8w | X | | | | | | | | National |
| Graduate Student Research Participation | G | 30 | 1 y | X | X | X | | X | X | | 30 | National |
| Graduate Student Thesis Research | G | 30 | 1 y | X | X | X | | X | X | | 30 | National |
| University Research Opportunities Program | U | | 2 m | X | X | X | | X | X | | 8 | National |
| Science Fair Grading | S (9-12) | | 5 d | | X | | X | X | | | 200 | MA |
| Tours | General | | 5 d | X | X | X | | X | | | 500 | MA |

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‡Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## BONNEVILLE POWER ADMINISTRATION

**Washington, D.C.**

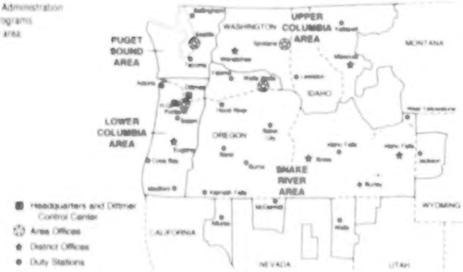
Bonneville Power Administration (BPA) is a U.S. Department of Energy power marketing administration that has provided service to the Pacific Northwest for more than 50 years. BPA provides wholesale electric power service to a 300,000 square mile area that encompasses Oregon, Washington, Idaho, western Montana, and portions of several other states in the Columbia River drainage basin. As part of its mission, the BPA plans and acquires generation and conservation resources in the region, plans and constructs regional and interregional transmission facilities, plans for the equitable distribution of the benefits of the Federal Columbia River Power System among regional utilities, and carries out fish- and wildlife-related mitigation and enhancement measures. The BPA uses revenues from the sale of power and transmission services to recover the costs of operating the system; to repay the federal investment in the system; and to back the financing of new power generation and transmission facilities, conservation measures, and fish and wildlife activities.

**EDUCATIONAL PROGRAM CONTACTS**

Roger Seifert
Bonneville Power
Administration
U.S. Department of Energy
Washington, DC 20585
(202) 586-5640

Rita Owen
Bonneville Power
Administration
P.O. Box 3621, EA
Portland, OR 97208-3621
(503) 231-6860

The Bonneville Power Administration supports education programs throughout its service area


PUGET SOUND AREA
WASHINGTON
UPPER COLUMBIA AREA
MONTANA
LOWER COLUMBIA AREA
OREGON
IDAHO
SNAKE RIVER AREA
WYOMING
CALIFORNIA
NEVADA
UTAH
■ Headquarters and Dittmer Control Center
Area Offices
District Offices
● Duty Stations

## BONNEVILLE POWER ADMINISTRATION

| | Audience¹ | Page Description in Catalog | Typical Duration in Days (d) Weeks (w) Months (m) Years (y) | Summer Activities | Academic Year Activities | On-Site Activities² | Off-Site Activities² | Direct Staff Involvement | Participants Receive Stipends³ | Instructional Materials Available | Annual Participation | Geographical Focus of Program (Principal States or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Apprenticeships in Science and Engineering Program | S (K-12) | | 2 m | X | | X | X | X | X | X | 30 | OR, WA |
| CHOICES | S (6-9) | | 9 m | | X | X | X | | | X | 280 | OR, WA |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | X | X | X | | | X | 500 | WA |
| Education Service District (ESD) | S (6-12) | | 2 d | | X | | X | X | | X | 600 | AK, CO, ID, IN, MT, ND, OR, WA |
| Energy Source Curriculum | S, T (K-6) | 19 | Varies | | | X | X | X | | X | 34 | OR, WA |
| Experiential School Program | S (K-12) | | 5 d | | X | X | | X | | | 22 | OR |
| Grant Cluster Alliance | S (6-12) | | 5 d | | X | X | | X | | | 100 | OR |
| Hands-On Science (HOS) | S (pre-K-6) | | 24 d | | X | X | X | X | X | | 1200 | OR, WA |
| Industry Initiatives for Science and Math Education | T (K-12) | | 3 m | X | X | X | X | X | X | X | 38 | OR, WA |
| Junior Engineering Technical Society (JETS) Fair | S (9-12) | | 2 d | | X | | X | X | | | 100 | OR |
| Mathematics, Engineering, and Science Achievement (MESA) | S (K-12) | | 9 m | | X | | X | X | | | 350 | WA |
| Minority Student Mentorships | S (K-12) | | 2 d | | X | X | X | | | | 6 | WA |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | | X | X | | | 480 | OR, WA |
| Oregon Museum of Science and Industry (OMSI) | S, T (K-12) | | 5 y | X | X | | | X | | | 5000 | OR |
| Partners-at-Large | S (K-12) | | 1 m | | X | X | X | X | | X | 500 | WA |
| Saturday Academy Futuremakers | S (K-12) | | 5 d | | X | X | X | X | | | 120 | OR |
| School/Business Partnership (David Douglas High School, Portland, Oregon) | S (K-12) | | 1 y | | X | X | X | X | | | 500 | OR |
| Science Olympiad | S (6-12) | | 2 d | | X | | X | X | | | 50 | OR, WA |
| Summer Science Camps | S (4-6) | | 10 d | X | | | X | X | | | 475 | OR |
| Talented and Gifted (TAG) | S (K-12) | | 10 m | | X | | X | X | | | 100 | OR, WA |
| [illegible] | | | | | | | | | | | | |
| Adjunct Faculty Appointments | F | | 3 m | | X | | X | | X | X | 10 | OR, WA |
| Electric Energy Industry Consortium, Seattle | F | | Varies | X | X | X | X | X | | X | 5 | WA |
| Howard University Research Grants | U, G | | 12 m | X | X | X | X | X | X | | 10 | |
| Prairie View A&M Cluster Grant | U, G | | 12 m | X | X | X | X | X | X | | 10 | |

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Final electrical connections are made to the rocket built by a young student at the Summer Science Camp at Woodlawn sponsored by the Bonneville Power Administration.

## BROOKHAVEN NATIONAL LABORATORY

**Upton, New York**

Operated by Associated Universities, Inc.

Brookhaven National Laboratory (BNL) conceives, develops, constructs, and operates complex research facilities for the study of fundamental properties of matter. BNL conducts basic and applied research in technology-base areas, supports research facilities, and establishes important new directions for research. Major disciplinary strengths at BNL are high-energy, nuclear, and solid-state physics; chemistry; and biology. The primary program areas at BNL are high-energy physics, basic energy sciences, biological and environmental research, and nuclear physics.

**DESIGNATED SCIENTIFIC USER FACILITIES**
Alternating Gradient Synchrotron
Double MP-Type Tandem Accelerator Facility
High Flux Beam Reactor
JSW168 Small Cyclotron
National Synchrotron Light Source
Relativistic Heavy Ion Collider (under construction)
Scanning Transmission Electron Microscopy Facility
60-Inch Cyclotron

**EDUCATIONAL PROGRAM CONTACT**
Karl Swyler
Educational Programs
Brookhaven National Laboratory
14 Brookhaven Avenue, Bldg. 438
Upton, NY 11973
(516) 282-7171

Chuckwudi Perry, G. Bernard Conyers, and Erica Thompson, winners of the 49th annual Beta Kappa Chi national science competition, spent a summer doing research in the Undergraduate Student Research Participation (SRP) program at Brookhaven National Laboratory, cosponsor of the competition with the National Institute of Science.

## BROOKHAVEN NATIONAL LABORATORY

| | Audience (Grades or Majors in Years) | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Residential Activities | Academic Year Activities | Summer Activities | Off-Site Activities | On-Site Activities | Participants Receive Stipends | Instructional Materials Available | Annual Participation | Geographic Area of Recruitment (National, State or Local) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Community Summer Science Program | S, T (11-12) | | 2 m | X | | X | | X | X | | 28 | NY |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | X | X | X | X | | X | 1000 | NY |
| Elementary School Science Fair | S, T (K-6) | | 1 d | | X | X | X | X | | X | 1080 | NY |
| Environmental Education Outreach for Minorities | S, T, F (9-12) | | 30 d | X | X | X | X | X | X | | 62 | NY |
| High School Co-Op Program | S (10-12) | | 10 m | | X | X | | X | X | | 16 | NY |
| High School Research Apprenticeship Program | S, T (9-10) | 12 | 1 m | X | | X | X | X | X | X | 43 | NY |
| High School Science Student Honors Program | S, T (11-12) | 11 | 14 d | X | | X | X | X | X | X | 65 | National |
| Inner City Outreach Program | S, T (10-12) | | 1 m | X | | X | X | X | X | | 533 | NY |
| In-Service Courses for Secondary School Teachers | T (7-12) | | 15 d | | X | X | | X | | | 34 | NY |
| Introduction to Computers | S, T (5-8) | | 10 d | | X | | X | X | | | 119 | NY |
| MAGLEV Contest | S, T (7-12) | | 1 d | | X | | X | X | | X | 370 | NY |
| Magnets-to-Go | S (5) | | 25 d | | X | X | X | X | | | 3000 | NY |
| Minisemester Programs | S, U, T (9-16) | | 5 d | | X | X | | X | X | | 25 | NY |
| Model Bridge Building Contest | S, T (9-12) | | 1 d | | X | X | X | X | | | 665 | NY |
| Model Bridge Building Seminar | T (9-12) | | 25 d | | X | X | | X | | | 50 | NY |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | | X | X | | | 192 | NY |
| Northeast Consortium | S, T (8-10) | | 1 d-1 m | X | X | X | X | X | X | | 120 | MA, NY |
| Science Discovery | S (pre-K-3) | | 25 d | | X | X | | X | | | 3000 | NY |
| Science Explorations | S, T (7-8) | | 1 d | | X | X | | X | | | 610 | NY |
| Science Fair Seminar | T (K-8) | | 25 d | | X | X | | X | | | 50 | NY |
| Scientists in Residence | S, T (K-6) | | 20 d | | X | | X | X | | | 200 | NY (Local) |
| Summer Apprenticeship Research Program for Minorities | S, T (10-12) | | 1 m | X | | X | X | X | X | | 43 | NY |
| Teacher Research Associates (TRAC) Program | T | 16 | 2 m | X | X | X | X | X | X | | 24 | National |
| Youth on Campus | S | | 10 w | X | | X | | X | X | | 21 | NY |
| [illegible] | | | | | | | | | | | | |
| BNL Scientific Tours | T, S, U, G | | 25 d | | X | X | | X | | | 1600 | National and International |
| Brookhaven Semester Program | U, F | | 16 w | X | X | X | X | X | X | | 1 | National |
| Community College Student Research Apprenticeship Program | U | | 10 w | X | | X | X | X | X | X | 1 | NY |
| Engineering Co-Op | U | | 2 y | | X | X | | X | | | 4 | National |
| Faculty Research Participation | F | [illegible] | 2 m | X | X | X | | X | X | | 71 | National |
| Fellows in Accelerator Technology | G | | 2 y | | X | X | X | X | X | | 1 | National |
| Gallaudet University Program | U, F | [illegible] | 2 m | X | X | X | | X | X | | 5 | DC |
| Graduate Education for Minorities (GEM) Program | G | | 2 m | X | | X | | X | X | | 3 | National |
| Graduate Student Thesis Research | G, F | [illegible] | | X | X | X | | X | | | 675 | National |
| Health Physics Trainee Program | G | | 2 m | X | | X | X | X | X | | 3 | National |
| National Physical Science Consortium | G | | 6 y | X | | X | X | X | X | | 2 | National |
| New York University School of Education | G | | 6 w | X | X | X | | X | X | | 10 | NY |
| Nuclear Chemistry Summer School | U | | 6 w | X | | X | X | X | X | | 12 | National |
| Postdoctoral Research Appointments | P | | 3 y | | X | X | | X | X | | 72 | National |
| Renate W. Chapman Scholarship for Women | U, G | | 1 y | | | X | | | X | | 1 | NY |
| Science and Engineering Opportunities Program for Minorities and Women | U | | 3 m | X | | X | | X | X | | 24 | NY |
| Science and Engineering Research Semester (SERS) | U | [illegible] | 10 w | | X | X | X | X | X | | 39 | National |
| Summer Intern Program | U | | 10 w | X | | X | | X | X | | 7 | National |
| Undergraduate Student Research Participation (SRP) | U | [illegible] | 10 w | X | | X | | X | X | | 69 | National |
| Workshops and Conferences | U, G, F, P | | 1-5 d | X | X | X | X | X | | | 350 | National |

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## BROOKHAVEN NATIONAL LABORATORY

| PUBLIC UNDERSTANDING OF SCIENCE AND OTHER | Audience¹ | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Academic Year Activities | Summer Activities | On-Site Activities² | Off-Site Activities² | Direct Staff Involvement | Students Receive Stipends³ | Instructional Materials Available | Annual Participation | Geographical Focus of Program (Principal States or Cities) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Career Awareness | S, T (10-12) | | 1-2 d | | x | X | | X | | | 281 | NY |
| Science Museum Tours | S, T (K-P) | 48 | 25 d | X | x | X | | X | | | 21000 | NY |
| Speakers Bureau | S, T (K-U) | | 25 d | | x | | x | X | | | 2300 | NY |

¹Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses; U for undergraduate students; G for graduate students; F for college or university faculty; and P for postgraduates.
²On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).
³Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

Kristen Ryan, a fourth grader at Charles Walters School in Middle Island, New York, won first place in her grade level at the Elementary School Science Fair sponsored by Brookhaven National Laboratory.

WHAT IS THE BIODEGRADABILITY OF COMMON DETERGENTS?
YES OR NO

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A young visitor discovers the sounds of science during a tour at the Brookhaven National Laboratory Science Museum

Flanked by his mentor, Mark Rivers, and his parents, Craig and Toni Thorn, Kurt Thorn displays some of the data he produced with a trace-element microprobe at Brookhaven National Laboratory's National Synchrotron Light Source. His use of the probe to investigate the elemental content of clam shells as an indicator of pollution won him the Westinghouse Science Talent Search

Brad Terris of Setauket, New York, holds his winning entry, a trophy for his school, and a $150 Radio Shack gift certificate at the Model Bridge Building Contest sponsored by Brookhaven National Laboratory

## ■ CONTINUOUS ELECTRON BEAM ACCELERATOR FACILITY

**Newport News, Virginia**

Operated by the Southeastern Universities Research Association (SURA)

The Continuous Electron Beam Accelerator Facility (CEBAF) is being built as a national, designated, scientific user facility for nuclear-physics research. When operational in 1994, CEBAF will enable scientists to study the structure of atomic nuclei with unprecedented precision. The accelerator will use 338 superconducting, radio-frequency accelerating cavities. The computer-based accelerator control system, already operational, has been adopted at other laboratories.

**DESIGNATED SCIENTIFIC USER FACILITIES**

Entire Facility (under construction)

**EDUCATIONAL PROGRAM CONTACT**

Kathryn Strozak
Educational Programs Coordinator
Continuous Electron Beam Accelerator Facility
12000 Jefferson Avenue
Newport News, VA 23606
(804) 249-7028

In this experiment BEAMS participants learn "The Shape of Things."

## CONTINUOUS ELECTRON BEAM ACCELERATOR FACILITY

| | Audience[1] | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), or Years (y) | Academic Year Activities | Summer Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Staff Involvement | Participants Receive Stipends[3] | Instructional Materials Available | Annual Participation | Geographical Focus of Programs (Principal States or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adventures in Technology Equals Options in Math/Science (ATOMS) | S (7-8) | | 2 d | | X | X | X | X | | | 1900 | VA |
| Appalachian Regional Commission/CEBAF Summer Residential Program | S (11-12)<br>T (9-12) | | 2 w | X | | X | X | X | T only | | 9 S, 3 T | Appalachia |
| Becoming Enthusiastic About Math and Science (BEAMS) | S, T (5-6) | 19 | 5 d | | X | X | X | X | | X | 1250 | VA |
| CEBAF Science Series | S, T (6-12) | | 1 y | | X | X | | X | | | 3850 | VA |
| Cooperating Hampton Roads Organizations for Minorities in Engineering (CHROME) | S, T (7-12) | | 9 m | X | X | X | X | X | | | 1200 | VA |
| Cooperative Education Program | S (11-U) | | 18 m | X | X | X | | X | X | | 50 | VA |
| Field Trip Site | S, T (7-12) | | 1 d | X | X | X | | X | | | 1300 S<br>300 T | NC, VA |
| Regional Summer Institute | S (8-9) | | 2 m | X | | X | X | X | | | 75 | VA |
| School Outreach Program | S, T (K-12) | | 1 d | | X | X | X | X | | | 3000 | VA |
| Science Fair Award Program | S (7-12) | | 1 d | | X | | X | X | | | 8 | VA |
| Summer Teacher Enhancement Institute | T (6-12) | | 4 w | X | | X | X | X | X | | 50 | National |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | | X | | X | X | | 12 | National |
| Graduate Student Research Participation | G | 38 | 2-6 y | X | X | X | X | X | X | | 25 | National |
| Hampton University Graduate Studies (HUGS) at CEBAF | G | | 21 d | X | | X | X | X | | | 15 | National and International |
| Physics Lecture Series | G, F, P | | 1 y | | X | X | | X | | X | 23 | VA |
| Southeastern Universities Research Association (SURA) Graduate Fellowship Program | G | | 1 y | X | X | X | X | X | X | | 4 | National |
| Traveling Lecture Program | U, G, F | | 1 d | | X | | X | X | | X | 400 | National |
| Undergraduate Student Research Participation (SRP) | U | 33 | 3 m | X | X | X | | X | X | | 100 | National |
| Visiting Scholars Program | F | | 10 d | X | X | X | X | X | X | | 20 | National and International |
| Community Liaison Program | General | | 1 d | X | X | X | X | X | | | 6000 | NC, VA |
| Program Follow-Up Assessment | General | | | | | | | X | | | | |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## FERMI NATIONAL ACCELERATOR LABORATORY

**Batavia, Illinois**

Operated by Universities Research Associates, Inc.

The primary research and development program area at Fermi National Accelerator Laboratory (Fermilab) is high-energy physics. In this program area, elementary-particle physics is explored to broaden the understanding of the basic structure of matter. Improvement of accelerator design at Fermilab has resulted in numerous technical spinoffs: the development of superconductivity on an industrial scale, fast electronics and particle-detector technology, and special computers and computer programs. The linear accelerator at Fermilab is used in cancer therapy, and the laboratory has become heavily involved in medical radiation therapy.

### DESIGNATED SCIENTIFIC USER FACILITIES

Entire facility including:
- 1000-GeV Superconducting Accelerator System
- Antiproton Source
- Colliding-Beam Areas
- Meson Experimental Area
- National Environmental Research Park
- Neutrino Experimental Area
- Proton Experimental Area

### EDUCATIONAL PROGRAM CONTACT

Stanka Jovanovic
Education Office, MS 206
Fermi National Accelerator Laboratory
P.O. Box 500
Batavia, IL 60510
(708) 840-3092

Middle school teacher Darryl Samborski tests his handmade electric motor in the "Motors to Microphones" Science Adventure at Fermilab. In this Adventure, teachers built microphones, loudspeakers, headphones, and other devices that illustrate the laws of electromagnetism. Ideas presented by Japanese physics teachers at the United States–Japan–China conference on physics education inspired this novel approach to teaching these fundamental concepts.

## FERMI NATIONAL ACCELERATOR LABORATORY

| | Audience | [illegible] | Typical Duration in Days (d), Period in Months (m) or Years (y) | [illegible] | Academic Year Activities | [illegible] | On-Site Activities | [illegible] | Participants Receive Stipends | [illegible] | Annual Participation | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **[illegible]** | | | | | | | | | | | | |
| Beauty and Charm at Fermilab | S, T (6-9) | | 2 d (S)<br>1.5 d (T) | | X | X | X | X | | X | 2223 S<br>155 T | III, V, IV, VIII |
| Biology West, Chemistry West, and Physics West | T (9-12) | | 9 d | | X | | X | | | | 643 | V |
| Cryogenic Show | S, T (K-12) | | 5 d | X | X | | X | X | | | 10864 S | V |
| Down to Earth | S, T (6-8) | | 5 d | X | X | X | | | | X | 112 S<br>28 T | V |
| Earth Day Poster Contest | S (K-6) | [illegible] | 1 d | | X | X | X | | | X | 100 | V |
| Ecology Field Trips | S (K-12) | | 5 d | X | X | X | | X | | | 686 | V |
| Expanding Your Horizons | S (6-8) | | 1 d | | X | | X | | | | 300 | V |
| Explorer Scouts | S (9-12) | | Oct.-May | | X | X | | X | | | 25 | V |
| Fermilab Hands-On Science | S, T (K-6) | | 10 d (S)<br>5 d (T) | | X | X | X | | | X | 1800 S<br>114 T | V |
| Fractals, Chaos, and Dynamics | T (6-12+) | | 5 d | X | | X | | | | X | 87 | National |
| High School Science Student Honors Program | S (9-12) | [illegible] | 14 d | X | | X | | X | | | 58 | National |
| High School Student Research Apprenticeship Program: Target | S (9-12) | [illegible] | 30 d | X | | X | X | X | X | | 25 | V |
| Illinois Minority Precollege Internship Program | S (9-12) | | 10 w | X | | X | | X | X | | 1 | V |
| Materials Programs | T (K-12) | | | | | | | | | X | | National |
| Mid-Level Science Network | T (6-8) | | 9 d | | X | | X | | | | 170 | V |
| National Science Bowl® | S (9-12) | [illegible] | 1 d | | X | | X | X | | | 175 S<br>35 T | V |
| National Teacher Enhancement Project | T (6-8) | | 19 d | X | X | X | X | X | X | X | 35 | V |
| New Explorers Partners | S, T (3-12) | [illegible] | 10 d (S)<br>15 d (T) | | X | X | X | X | X | X | 12 T | V |
| Night Lights | T (4-6) | | 1.5 d | | X | X | | X | | X | 40 | V |
| Particles and Prairies | S, T (6-8) | [illegible] | 1 d (S)<br>4 d (T) | | X | X | X | X | | X | 602 S<br>23 T | V |
| Physics Minicourses | S, T (9-12) | | 1 d | X | X | | X | X | X | X | 100 S<br>46 T | National |
| Quarks to Quasars | S, T (4-12) | | 5 d | X | X | X | X | X | | X | 800 S<br>257 T | IV, III, V, VIII |
| Resources for the Science Classroom | T (K-12) | | | | | | | | | X | | V |
| Saturday Morning Physics at Fermilab | S (9-12) | | 10 d | | X | X | | X | | | 300 | V |
| Science Adventures | S, T (K-6) | | 2 d | | X | X | | | | | 221 | V |
| Summer Institute for Science and Math Teachers (Chicago) | T (9-12) | | 20 d | X | X | X | X | X | X | X | 60 | V, IV |
| Summer Youth Employment Training Program | S (9-12) | | 3 m | X | | X | | X | X | | 3 | V |
| Teacher Research Associates (TRAC) Program/TRAC Grad | T (6-12) | [illegible] | 40 d | X | | X | | X | X | | 13 | National |
| Topics in Modern Physics | T (9-12) | | 15 d | X | X | X | X | X | X | X | 46 | National |
| Weird Science | S, T (K-12) | | 5 d | X | X | | X | | | | 5600 S<br>7200 T | National |
| Wonders of Science | S (3-8) | | 5 d | | X | X | | | | | 385 | V |
| **[illegible]** | | | | | | | | | | | | |
| Consortium for Graduate Degrees for Minorities in Engineering | G | | 12 w | X | X | | | | | | 3 | National |
| Doctoral Fellowships in Physics | G | | 3 y | | X | X | X | X | X | | 5 | National |
| Doctoral Program in High-Energy Physics in Collaboration with Latin American Countries | G | | 2-3 y | X | X | X | | | | | 1 | National |
| Faculty Research Participation | F | [illegible] | 2 m | X | X | X | | X | X | | 2200 | National |
| Graduate Fellowships | G | [illegible] | Varies | X | X | X | | X | X | | | National |
| Graduate Student Research Participation (GSRP) | G | [illegible] | Varies | X | X | X | X | X | | | 575 | National |

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## FERMI NATIONAL ACCELERATOR LABORATORY

| | Audience¹ | Page Description in Catalog | Typical Duration in Days (d) Weeks (w) Months (m) Years (y) | Academic Year Activities | Summer Activities | On-Site Activities² | Off-Site Activities² | Direct Staff Involvement | Participants Receive Stipends³ | Instructional Materials Available | Annual Participation | Geographical Focus of Program (Program Site(s) or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Physics Department Intern Summer Appointments | U | | 10 w | X | | X | X | | X | X | 25 | National |
| Postdoctoral Research Appointments | P | | 2-3 y | X | X | X | X | X | X | | 62 | National |
| Summer Accelerator School | G, P | | 12 d | X | X | | X | X | X | X | 169 | National |
| Undergraduate Student Research Participation (SRP) | U | 33 | 10 w | X | | X | | X | X | | 25 | National |
| Vocational Post High School | U | | 4 w | X | | X | | X | X | X | 15 | National |
| Wilson Fellows/Lederman Fellow | P | | 3 y | X | X | X | X | X | X | | 5 | National |
| Workshops and Institutes | U, G, P, F | | Varies | X | X | X | | X | | | | National |
| [illegible] | | | | | | | | | | | | |
| Fermilab Tours | S, T (K-P) | | 5 d | X | X | X | | | | | 6000 | Regional |
| School Partnership Program | S, T (K-8) | 46 | Varies | | X | X | X | X | | X | 2680 S,<br>92 T | IL |
| Science and Human Values Lecture Series | General | | 25 d | | | X | | | | | | Regional |

¹Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

²On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.)

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Joyce Wu from Spanish River Community High School in Boca Raton, Florida, inspects photomultiplier tubes as part of her two-week assignment at Fermilab in the High School Science Student Honors Program in Particle Physics.

Students collect data and learn about collisions and scattering of subatomic particles at the Particle Pool, one of five teaching areas at the Leon M. Lederman Science Education Center at Fermilab, as part of the Quarks to Quasars Program.

Two advanced placement physics students from Fremd High School in Palatine, Illinois, use a Geiger counter to check the level of radioactivity emitted from a wristwatch at the Leon M. Lederman Science Education Center at Fermilab.

## FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

**Fernald, Ohio**

Operated by Fernald Environmental Restoration Management Corporation (FERMCO)

The Fernald Environmental Management Project (FEMP) produced a variety of uranium products that served as "feed materials" for defense programs from 1953 to 1989. In July 1989 production was suspended to concentrate on waste management; environmental restoration; and other environmental, safety, and health-compliance issues. The FEMP's new environmental mission is projected to continue well into the next century. Solving the environmental problems that have developed during more than 30 years will require not only careful study and rigorous attention to detail but also the development of additional expertise and new technology.

**EDUCATIONAL PROGRAM CONTACT**
Marvin C. Gross
Educational Outreach Department
Fernald Environmental Management Project
Post Office Box 398704
Cincinnati, OH 45239-8704
(513) 648-6553

Teachers from southwest Ohio participated in three workshops conducted by the Fernald Environmental Management Project and focusing on ground water; the workshops were components of the Chemical Education for Public Understanding Program (CEPUP) cosponsored by regional industries and government agencies.

## FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

| Program | Audience | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities | Off-Site Activities[a] | Direct Staff Involvement | Participants Receive Stipends[b] | Instructional Materials Available | Annual Participation | Geographical Focus of Programs (Principal States or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Chemical Education for Public Understanding Program (CEPUP) | T | | 1 d | X | x | | x | X | | X | 180 | IN, KY, OH |
| Council for Advancement of Science | T, F | 21 | Ongoing | X | x | | x | X | | | 30 | IN, KY, OH |
| DOE Document Review | T, S (10-12) | | 3 m | | x | | x | X | x | | 25 | OH |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | x | X | x | | | X | 500 | OH |
| Higher Education Outreach Program | S (8-12) | | 3 m | X | | X | | X | x | | 2 | OH |
| Mentor Program | S (5-12) | | 1 y | | x | | x | X | | | 10 | OH |
| National Science Bowl® | S (9-12) | 14 | 1 d | | x | | x | X | | | 160 | IN, KY, OH |
| New Explorers Partners | S, T (4-12) | 16 | 10 d | | x | | x | X | x | X | NP* | IN, KY, OH |
| Partners for Terrific Science | T | | 3.5 d | X | x | X | x | X | | X | 75 | IN, KY, OH |
| Partnership in Education | S (6-8) | | 1 d | | x | X | x | X | | X | 80 | OH |
| Science Fairs | S | | 1 d | | x | | x | X | | | 850 | OH |
| Science, Technology, Environment, and Me (STEM) Camps | S (5-8) | | 5 d | X | | | x | X | | | 130 | OH |
| Super Saturday Science | S (12) | | 1 d | | x | | x | X | | | 60 | OH |
| Teacher In-Service Programs | T | | 1 d | | x | X | x | X | x | | 160 | IN, KY, OH |
| Teacher Network | T | | 10 m | | x | | x | X | | | 20 | IN, KY, OH |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | | X | | X | x | | 4 | National |
| Teachers at Federal Facilities Program | T | | 2 m | X | | X | | X | x | | 6 | OH |
| **[illegible]** | | | | | | | | | | | | |
| Cooperative Education/Interns Program | U, G | | 3-6 m | X | x | X | | X | x | | 30 | KY, OH |
| Environmental Management Career Opportunities for Minorities (EMCOM) | U | | 2 y | X | | X | x | X | x | | NP* | |
| Environmental Management Career Opportunities Research Experience (EMCORE) | U | | 2 y | X | | X | x | X | x | | NP* | |
| Historically Black Colleges and Universities Program | U | | 3 m | X | x | X | | X | x | | 17 | KY, OH |
| **[illegible]** | | | | | | | | | | | | |
| Speakers Bureau | S, T | | 1 d | X | x | X | x | X | | | 3500 | IN, KY, OH |
| Tours | General | | 5 d | X | x | X | | X | | | 2000 | IN, KY, OH |

Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses; U for undergraduate students; G for graduate students; F for college or university faculty; and P for postgraduates.

[a] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[b] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

*New program in 1993; numbers not available.

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## IDAHO NATIONAL ENGINEERING LABORATORY

**Idaho Falls, Idaho**

Operated by EG&G Idaho, Inc.
Westinghouse Idaho Nuclear
Company, Inc.
Argonne National Laboratory–West

Seventy seventh graders participated in a DOE-sponsored Kid's Choice Summer Science Day Camp at the College of Southern Idaho in Twin Falls. During the week-long camp sponsored by the Idaho National Engineering Laboratory, they visited a fish hatchery, two geological areas, and the mountain stream spawning grounds of an endangered species.

Idaho National Engineering Laboratory (INEL) is a multiprogram laboratory. Historically a leader in the DOE reactor-technology programs and engineering projects, INEL conducts applied research and development to support the mission of DOE and other government agencies. INEL offers use of its unique facilities for the benefit of members of the technical community, cooperates with personnel in universities and industry to educate scientists and engineers, and provides technology transfer to the public and private sectors. Major INEL facilities are located in Idaho Falls, Idaho, and on an 890-square-mile tract west of Idaho Falls.

**DESIGNATED SCIENTIFIC USER FACILITIES**
Idaho National Engineering Laboratory (INEL)

**EDUCATIONAL PROGRAM CONTACTS**
DOE Office of External Affairs
Tiajuana Cochnauer
Educational Outreach Manager
Field Office, Idaho
785 DOE Place, MS 1214
Idaho Falls, ID 83401
(208) 526-9586

Connie Blackwood
INEL Office of Academic Programs
P.O. Box 1626
Idaho Falls, ID 83415-3500
(208) 526-9221

Doug Empey
University Relations and Outreach Coordinator
Westinghouse Idaho Nuclear Company
Idaho National Engineering Laboratory
Winco Box 4000, MS 1215
Idaho Falls, ID 83403
(208) 526-3119

## IDAHO NATIONAL ENGINEERING LABORATORY

| | Audience[1] | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Academic Year Activities | Summer Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Staff Involvement | Participants Receive Stipends[3] | Instructional Materials Available | Annual Participation | Geographical Focus of Program (Principal States or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Hispanic Youth Symposium | S (10-12) | | 3 d | X | x | | x | X | x | X | 300 | ID |
| Idaho Science Camp at University of Idaho | S (9-11) | | 2 w | X | | | x | | | | 80 | ID, NV, OR, WA |
| INEL Multicultural Progressive Science Camps | S (7-12) | | 5 d | X | x | | x | X | | X | 120 | ID, NV, OR |
| INEL Scholastic Tournament | S (9-12) | | 7 m | | x | X | x | X | | | 125 | ID |
| INEL Supercomputing Center Annual Technology Exploration Fair | S (K-12), T | | 1 d | | x | | x | X | | | 2300 | ID |
| INEL Volunteer Tutoring Program | S (5-U) | | 8 m | | x | | x | X | | | 350 | ID |
| Kids' Choice: Summer Science Day Camps | S (5-10) | | 1 w | X | | | x | | | | 400 | ID, MT |
| Magic Valley Mobile Science Laboratory | S, T (3-12) | | 9 m | | x | | x | X | | | 2000 | ID |
| Math Workshops | T (K-12) | | 1 w | X | | | x | | | X | 140 | ID |
| National Science Bowl® | S (9-12) | 14 | 1 d | | x | | x | X | | | 8 | ID |
| Physical Science Laboratory for Eighth Graders | S (8) | | 9 m | | x | | x | X | | | 2000 | ID |
| Physical Sciences Revealed for Intermountain Educators (PRIME) | T (7-9) | 21 | 5 d | X | | | x | X | | X | 40 | ID, MT, WY |
| Providing a Trusting Hand (PATH) | U | | Ongoing | X | x | X | x | | | | 10 | ID |
| Science Fairs | S (K-12) | | 1 m | | x | | x | X | | X | 7000 | ID, MT, WY |
| Students Investigating Today's Environment (SITE) | S (9-12), T | | 9 m | | x | | x | X | | X | 850 | ID |
| Teacher Research Associates (TRAC) Program | T (7-12) | 16 | 8 w | X | | X | | X | x | | 14 | National |
| Teachers Exploring Environmental Management (TEEM) | T (10-12) | | 2 w | X | x | X | x | X | | | 20 | ID |
| Teachers Teaching Teachers (T3): Elementary Physics and Chemistry Experiments | T (1-6) | | 1 w | X | | | x | | | X | 300 | ID, MT, WY |
| Teaching Nuclear Topics | T (K-12) | | 2 d | | | X | x | X | | X | 100 | ID, MT, WY |
| Technology Reaching Elementary Kids (TREK) | S (4-6) | | 9 m | | x | | x | X | | | 1500 | ID |
| [illegible] | | | | | | | | | | | | |
| Environmental Management Career Opportunities for Minorities (EMCOM) | U | | 2 y | X | x | X | x | X | x | | 4 | National |
| Environmental Management Career Opportunities Research Experience (EMCORE) | U | | 2 y | X | | X | x | X | x | | 10 | National |
| Faculty Fellowships | F | | 3 m | X | | X | | X | x | | 10 | National |
| Graduate Student Thesis Research | G, P | 38 | 3 m | X | | X | | X | x | | 16 | National |
| Hazardous Materials Technician Training | U | | 2 y | | x | X | x | | | | 16 | ID |
| Historically Black Colleges and Universities (HBCU) | U, G, F | | Varies | X | | X | | X | x | | 21 | National |
| Master's Degree in Environmental Management | G | | 2 y | X | x | X | x | X | | | 30 | ID |
| Minority Access to Energy-Related Research Careers (MAERC) | U, F | 30 | 2 y | X | | X | x | X | x | | 9 | CA |
| Nuclear Security Training | U | | 9 m | X | x | | x | | | | 48 | ID |
| PhD in Nuclear Engineering | G | | 6 y | X | x | X | x | X | | | 17 | ID |
| Student Fellowships | U, G | | 3 m | X | | X | | X | x | | 70 | National |
| [illegible] AND OTHER | | | | | | | | | | | | |
| Community Ambassadors | S (K-12) | | Ongoing | X | x | X | x | X | | | 7000 | ID, MT, UT, WY |
| IQ Line (INEL Query Line) | T (K-12) | | Ongoing | | x | X | x | X | | | 100 | National |
| Site Tours Program | General | | Ongoing | X | x | X | | X | | | 6000 | ID |
| Speakers Bureau | General | | Ongoing | X | x | X | x | X | | | 40000 | ID |
| Young Women's Career Day | S (7-12) | | 1 d | | x | | x | X | | | 720 | ID |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.
[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).
[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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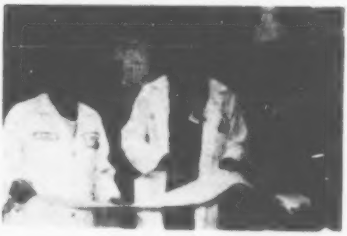
## ■ INHALATION TOXICOLOGY RESEARCH INSTITUTE

**Albuquerque, New Mexico**

Operated by Lovelace Biomedical and Environmental Research Institute

The Inhalation Toxicology Research Institute (ITRI) conducts basic and applied research to improve understanding of the nature and magnitude of the impacts on human health of inhaling airborne materials in the home, workplace, and general environment. Research programs at ITRI have a strong basic science orientation with emphasis on the nature and behavior of airborne materials, the fundamental mechanisms by which they cause disease, and the means by which data produced in the laboratory can be used to estimate risks to human health. As the largest laboratory dedicated to the study of basic inhalation toxicology, ITRI provides a national resource of specialized facilities, personnel, and educational activities serving the needs of government, academia, and industry.

**EDUCATIONAL PROGRAM CONTACT**
David Bice
Education Coordinator
Inhalation Toxicology Research Institute
P.O. Box 5890
Albuquerque, NM 87185
(505) 845-1019



Dr. Rogene Henderson discussing a data printout with a summer student at the Inhalation Toxicology Research Institute

## INHALATION TOXICOLOGY RESEARCH INSTITUTE

| | Audience¹ | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities² | Off-Site Activities² | Direct Staff Involvement | Participants Receive Stipends³ | Instructional Materials Available | Annual Participation | Geographic Focus of Program (National, State or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| High School Student Research Apprenticeship Program | S | 12 | 50 d | X | | X | X | X | X | | 4 | NM |
| Science Fair Involvement | S | | 3 d | | X | | X | X | | | | NM |
| Summer Teacher Enrichment Program (STEP) | T | 21 | 50 d | X | | X | X | X | X | | 4 | NM |
| Teacher Research Associates (TRAC) Program | T | 18 | 40 d | X | | X | | X | X | | 4 | National |
| Tours and Demonstrations for Area Students and Teachers | S (K-12) | | 10 d | X | X | X | | X | | | 150 | NM |
| [illegible] | | | | | | | | | | | | |
| Faculty Research Participation | F | 35 | 1 m-1 y | X | X | X | | X | X | | 5# | National |
| Graduate Student Research Participation (GSRP) | G | 36 | 5-6 y | X | X | X | | X | X | | 8 | National |
| Graduate Student Thesis Research | G | 38 | 2-3 y | X | X | X | | X | X | | 1 | National |
| Undergraduate Student Research Participation (SRP) | U | 33 | 50 d | X | X | X | | X | X | | 10 | National |
| [illegible] | | | | | | | | | | | | |
| Minority and Women Student Programs | U | | 10 w | X | | X | | X | X | | 4 | National |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

Ronald Herbert, participant in a program at the Inhalation Toxicology Research Institute, views the enlarged images and takes notes as Patrick Haley evaluates histopathologic changes induced by inhaled pollutants.

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## KANSAS CITY AREA OFFICE

**Kansas City, Missouri**

The Kansas City Division of AlliedSignal Inc. is one of the largest nonnuclear facilities within the U.S. Department of Energy's nuclear weapons complex. Today other government agencies and private industry are being offered sophisticated, state-of-the-art capabilities in electrical/electronics/optoelectronics, mechanical, rubber and plastics, and related services, which were originally developed for the weapons programs. These exceptional opportunities for technology transfer and work-for-others programs will help to improve America's small and medium-sized businesses so that they can become more competitive in the global market.

**EDUCATIONAL PROGRAM CONTACT**
Randy Williams
AlliedSignal Inc.
Kansas City Division
P.O. Box 419159
Kansas City, MO 64141-6159
(816) 997-2181

AlliedSignal engineer Bob Wehner observes students while teaching a World in Motion class.

## KANSAS CITY AREA OFFICE

| | Audience¹ | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities² | Off-Site Activities² | Direct Staff Involvement | Stipends³ | Instructional Materials Available | Annual Participation | Geographic Focus of Programs (Regional, States, or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **[illegible]** | | | | | | | | | | | | |
| America's Rising STARS | S, T (6-12) | | 1 y | X | X | | X | X | | X | 14000 | KS, MO |
| Career Fairs | S (2-12) | | 1 d | | X | | X | X | | | 5000 | KS, MO |
| Curriculum Assistance | S, T (8-12) | | 1 w | | X | | X | X | | | | KS, MO |
| Equipment Transfers | S, T (K-12) | | 1 y | | X | | X | | | X | | National |
| Greater Kansas City Science Fair | S (4-12) | | 4 d | | X | | X | X | X | | 1000 | KS, MO |
| National Science Bowl® | S, T (9-12) | 14 | 1 d | | X | | X | X | | | 900 | KS, MO |
| Plant Tours | S, T (8-12) | | 1 d | | X | X | | X | | | 150 | KS, MO |
| Sharefest Program | S, T (K-12) | | 1 y | X | X | X | X | X | | X | 1000 | KS, MO |
| Speakers Bureau | S, T (2-12) | | 1 d | X | X | | X | X | | | | KS, MO |
| Summer Employment Program | T | | 3 m | X | | X | | X | X | | 2 | KS, MO |
| The Resource Expo | T (K-12) | | 1 d | | X | | X | X | | X | 120 | KS, MO |
| World in Motion | S, T (4-6) | 28 | 9 m | | X | | X | X | | X | 12000 | KS, MO |
| **[illegible]** | | | | | | | | | | | | |
| Curriculum Assistance | U, F | | 1 w | | X | | X | X | | | | KS, MO |
| Design Team Projects | U, F | | 1 y | | X | X | X | X | | X | 20 | KS, MO |
| Plant Tours | U, F | | 1 d | | X | X | | X | | | 50 | KS, MO |
| Speakers Bureau | U, F | | 1 d | X | X | | X | X | | | | KS, MO |
| Summer Employment | U | | 3 m | X | | X | | X | X | | 5 | KS, MO |
| Summer Training for Teachers | F | | 3 m | X | | | X | X | | X | 15 | KS, MO |
| **[illegible] AND OTHER** | | | | | | | | | | | | |
| FOCUS on the Environment Newsletter | General | | 4 per y | | | | | | | X | 2000 | Kansas City area |
| School Partnership Programs | S, T (K-12) | 45 | 1 y | | X | X | X | X | | | 8000 | MO |
| Speakers Bureau | General | | 1 y | X | X | | X | X | | | 100 | KS, MO |

¹Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses; U for undergraduate students; G for graduate students; F for college or university faculty; and P for postgraduates.

²On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

³Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

AlliedSignal employee Henry Glass performs a demonstration while teaching a World in Motion class.

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## LAWRENCE BERKELEY LABORATORY

**Berkeley, California**

Operated by the University of California

Lawrence Berkeley Laboratory (LBL) is a multiprogram DOE laboratory. The oldest of the DOE laboratories, LBL is located next to the University of California, Berkeley.

LBL supports a wide range of research activities in fields ranging from astrophysics to energy conservation. LBL's role is to serve the Nation and its scientific and educational communities through energy-related research performed in its unique facilities. LBL has a four-part mission: (1) perform leading multidisciplinary research in energy sciences, general sciences, and life sciences; (2) develop and operate unique national experimental facilities for use by qualified investigators; (3) educate and train future generations of scientists and engineers; and (4) foster productive relationships between LBL research programs and industry.

Current programs encompass all the natural sciences as well as engineering, mathematics, and computer science. Basic studies of the nature of the atom and the cell; research on new treatments for cancer patients; and the development of advanced materials, instruments, facilities, and new energy sources are typical examples of LBL research.

### DESIGNATED SCIENTIFIC USER FACILITIES

Advanced Light Source (under construction)
Bevalac
88-Inch Cyclotron
National Center for Electron Microscopy
National Tritium Labeling Facility

### EDUCATIONAL PROGRAM CONTACT

Roland Otto
Center for Science and Engineering Education
Bldg. 938C
Lawrence Berkeley Laboratory
One Cyclotron Road
Berkeley, CA 94720
(510) 486-5325

Zoretta Ward from Jackson State University gets instruction in proper laboratory technique from David Lawrence of Lawrence Berkeley Laboratory's Cell and Molecular Biology Division as part of their Minority Institution Laboratory Alliances.

## LAWRENCE BERKELEY LABORATORY

| | Audience[1] | Page Description in Catalog | Typical Duration | Academic Year Activities | Summer Activities | On-Site Activities[2] | Off-Site Activities[2] | [illegible] | [illegible] | [illegible] | Annual Participants | Geographical Focus of Program |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Bay Area Science and Technology Education Collaboration (BASTEC) | S, T (K-12) | 19 | | X | x | X | x | X | x | X | 4139 | CA |
| Community Outreach Program | S, T (K-12) | | 5 d | X | x | X | x | X | | X | 200 | CA |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | x | X | x | | | X | 100 | Northern CA |
| Hands-On Universe | S, T (10-12) | 10 | 3 y | X | x | X | x | X | x | X | 40 | National |
| High School Science Student Honors Program | S (9-12) | 11 | 14 d | X | | X | x | X | | | 64 | National |
| Mathematics Network Initiative[4] | S, T (K-12) | | 40 d | X | x | X | x | X | x | | 200 | CA |
| Mathematics Outreach Initiative[4] | S, T (K-12) | | 30 d | X | x | X | x | X | x | | 2000 | CA |
| National Science Bowl® | S (9-12) | 14 | 1 d | | x | | x | X | | | 108 | CA |
| Science Education Academy of Bay Area | T (K-12) | | 15 d | X | x | X | x | X | | | 2000 | CA |
| Teacher Research Associates (TRAC) Program | T (7-12) | 16 | 2 m | X | | X | | X | | X | 40 | National |
| **UNDERGRADUATE AND GRADUATE** | | | | | | | | | | | | |
| Access to Science Teaching Careers (ASTC) | U | | 10 w | X | x | X | x | X | x | | 5 | CA |
| California Community College Transfer | U | | 10 w | X | x | X | | X | x | | 6 | CA |
| Environmental Management Career Opportunities for Minorities (EMCOM) | U, F | | 10 w | X | x | X | | X | x | | 6 | Various |
| Environmental Management Career Opportunities Research Experience (EMCORE) | U | | 10 w | X | x | X | | X | x | | 0 | National |
| Faculty Research Participation | F | 25 | 10 w | X | | X | | X | x | | 2 | Various |
| Faculty/Student Team Research | U, F | 26 | 10 w | X | x | X | | X | x | | 6 | [illegible] |
| Graduate Student Thesis Research | G | 28 | 4 y | X | x | X | | X | x | | 500 | Local |
| Minority Access to Energy-Related Research Careers (MAERC) | U | 30 | 10 w | X | x | X | | X | x | | 12 | CA |
| Minority Institution Laboratory Alliances | U, G, F | 31 | 10 w | X | x | X | x | X | x | | 50 | [illegible], PR, and various US states |
| Partnership for Environmental Technology Education (PETE) | U, F | 32 | 2 d/8 w | X | x | X | x | X | x | | U 2,<br>F 200 | AZ, CA, HI, NV, UT |
| Postdoctoral Research Appointments | P | | 2 y | X | x | X | | X | x | | 0 | |
| Science and Engineering Research Semester (SERS) | U | 33 | 4 m | | x | X | | X | x | | 50 | National |
| Undergraduate Student Research Participation (SRP) | U | 35 | 10 w | X | x | X | | X | x | | 15 | National |
| **[illegible]** | | | | | | | | | | | | |
| School Partnership Programs | S, T (K-12) | 48 | 1 d | | x | | x | X | | X | 650 | CA |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses; U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

[4] Planned start FY94.

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## LAWRENCE LIVERMORE NATIONAL LABORATORY

**Livermore, California**

Operated by the University of California

Lawrence Livermore National Laboratory (LLNL) was established in 1952 to perform research on nuclear weapons and magnetic fusion energy. Since then, the mission has expanded to include research in other areas, including laser fusion and laser isotope separation, biomedical and environmental sciences, applied energy technology, and a broad range of beam-technology issues. These programs, in turn, are supported by research in basic scientific disciplines, computer science and technology, engineering, materials science, and physics.

The laboratory has particular strengths in scientific and engineering software, biotechnology, advanced materials, precision engineering, laser and electro-optic technology, microelectronics and instrumentation, and measurement technology.

**DESIGNATED SCIENTIFIC USER FACILITIES**
National Gene Library Project
National Magnetic Fusion Energy Computation Center

**EDUCATIONAL PROGRAM CONTACT**
Eileen Vergino
Education Program
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, CA 94550
(510) 424-0567

Bill Pence, who is a high school teacher from California High in San Ramon, California, and a Lawrence Livermore National Laboratory Global Climate Change Workshop presenter, demonstrates an experiment to exchange students from Troitsk, Russia, and their chaperones.

## LAWRENCE LIVERMORE NATIONAL LABORATORY

| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Apprenticeship and Pre-Apprenticeship Program | S | | 1-4 y | X | x | X | x | X | x | | 40 | National |
| Bay Area Science and Technology Education Collaboration (BASTEC) | S, T (K-12) | 27 | Ongoing | X | x | X | x | X | x | X | 4138 | CA |
| Energy Awareness Poster Contest | S (K-6) | | 1 m | | x | X | x | X | | | 12000 | CA (local) |
| Equipment Loan Program | S, T (K-12), U | | Ongoing | X | x | | x | | | | | National |
| Expanding Your Horizons Science and Mathematics Conference | S (6-12) | | 1 d | | x | | x | X | | | 600 | CA (local) |
| Explorer Post (Boy Scouts of America) | S (6-12), U | | Ongoing | | x | X | | X | | | 130 | National |
| Free Educational Electronic Mail Network (FrEdMail) | S, T (K-12), U | | Ongoing | X | x | X | x | X | | X | 112 | CA (local) |
| Global Climate Change Curriculum | T (K-12) | 10 | 3 d | X | x | X | x | X | x | X | 300 | National |
| Hands-On Experimental Laboratory Program (HELP) | T (K-8) | | 3 d | | x | | x | X | | X | 20 | CA |
| Helping Our Partners Enrich Science (HOPES) | T (K-8) | | 6 w | X | | X | | X | x | X | 62 | National |
| High School Science Student Honors Program | S (11-12) | 11 | 14 d | X | | X | x | X | x | | 50 | National |
| High School Summer Program | S (11-12) | | 3 m | X | | X | | X | x | | 6 | CA (local) |
| JUNTOS (Bilingual Family Learning Program) | S (K-8) + parents | | 5 w | X | x | | x | X | | X | 20 | CA (local) |
| Laser and Fusion Energy Education Program | S, T (K-12), U | | Varies | X | x | X | x | X | | X | 250 | National |
| Logo/Logo Classes | T (K-8) | | 1 w | X | | X | | X | | X | 12 | CA |
| LESSON (Lawrence Livermore National Laboratory Elementary School Science Study of Nature) | T (K-6) | 12 | 2.5 w | X | x | | x | X | | X | 250 | National |
| Livermore Computer Center—Computer Museum | S, T (K-12), U | | Ongoing | X | x | X | | X | | | 700 | CA |
| Logo Classes | S, T (K-8) | | 4 d | | x | X | | X | | X | 262 | CA |
| Math Challenge Day | S (6-12) | | 1 d | | x | | x | X | | | 120 | CA |
| Mechanical Engineering Summer Technical Institute | T (9-12), U | | 2 w | X | | X | | X | | X | 60 | National |
| Minority High School Student Research Apprentice Program (MH) | S, T (11-12) | | 8 w | X | | X | x | X | | | 7 S, 2 T | National |
| Multimedia Program | T (K-12) | | 1.3 w | X | x | X | x | X | | X | 50 | CA (local) |
| National Education Supercomputer Program (NESP) | S, T (9-12) | 10 | 2 w | X | x | X | x | X | | x | 200 S, 550 T | National |
| National Science Bowl® | S (9-12) | 10 | 1 d | | x | | x | X | | | 80 | National |
| Plant Engineering Experience Program (PEEP) | S (11-12) | | 2 y | X | x | X | | X | x | | 6 | CA (Livermore Sch. District) |
| Principals for the Advancement of Leadership in Science (PALS) Network | T (K-8) | | 2 d | | x | X | | X | | X | 30 | CA |
| Science Education Academy of the Bay Area (SEABA) | S, T | | 1 y | X | x | X | x | X | x | X | | CA (local) |
| Science on Site (SOS) | T (K-8) | | 1 d | | x | | x | X | | X | 150 | CA |
| Speakers Bureau | S, T (K-12), U | | 5 d | | x | | x | X | | | 1500 | CA (local) |
| Student Technology Experience Program (STEP) | S (9-12), U | | Ongoing | X | x | X | | X | x | | 15 | CA (local) |
| Summer Research Internship Program | T (K-12) | | 3 m | X | | X | | X | x | X | 34 | National |
| Summer Student/Faculty Internship Program | S, T (9-12), U | | 12 w | X | | X | | X | x | | 10 | National |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 8 w | X | | X | | X | x | X | 8 | National |
| Technical Volunteers | S, T (K-12), U | | Ongoing | X | x | | x | X | | | 25 | CA (local) |
| United States/Russia Exchange Program | S, T (9-12) | | 1 d | X | x | X | | X | | | 100 | CA |
| [illegible] | | | | | | | | | | | | |
| American Indian Program | S, T (K-12), U<br>G, F | | 3 d-1 w | X | x | X | x | X | x | X | 20000 | AR, CA, CO<br>NM, UT, WA |
| Co-Operative Education Program | U | | 3-6 m | X | x | X | | X | x | | 3 | National |

*Continued*

## LAWRENCE LIVERMORE NATIONAL LABORATORY

| | Audience¹ | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Historically Black Colleges and Universities Program | U, F | | Ongoing | X | X | X | X | X | X | | | LA, MS, TX, VA, WA |
| Minority Institution Laboratory Alliances | U, F | 21 | Varies | X | X | X | X | X | X | | | AL, LA, MS, TX |
| National Consortium for Graduate Degrees for Minority Engineers | P | | 3 y | X | X | X | X | X | X | | 6 | National |
| National Physical Science Consortium for Graduate Degrees—Minorities and Women | P | | 6 y | X | X | | X | X | X | | 20 | National |
| National Physics Education Collaboration Program (NPEC) | U | | 6 w | X | X | X | X | X | X | | 12 | National |
| Navajo Community College Computer Science Co-Operative Education Program | U | | 6 m | X | X | X | | X | X | | 1 | NM |
| Postcollege Appointment Program | G | | 2 y | X | X | X | | X | X | | 2 | National |
| Postdoctoral Research Staff Members (Postdoc) | P | | 2 y | X | X | X | | X | X | | 123 | National |
| Science and Engineering Research Semester (SERS) | U | 20 | 4.5 m | | X | X | X | X | X | | 35 | National |
| Summer Employment Program (SEP) | U, G | | 11 w | X | | X | | X | X | | 325 | National |
| Summer Research Participation Program | U, G, F | | Varies | X | X | X | | X | X | | 40 | National |
| Undergraduate Fellow Program—Summer School in Nuclear Chemistry | U | | 8 w | X | | | X | X | X | | 24 | CA, NY |
| Undergraduate Summer Institute on Contemporary Topics—Applied Science | U | | 2 w | X | | X | X | X | X | | 60 | National |

¹Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.
²On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).
³Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

A Lawrence Livermore National Laboratory scientist demonstrates a simple experiment on carbon dioxide to elementary school teachers in a LESSON workshop.

The Southwest Indian Polytechnic Institute (SIPI) Upward Bound Program participated in Countdown to Supercomputing at Lawrence Livermore National Laboratory's National Energy Research Supercomputer Center

## LOS ALAMOS NATIONAL LABORATORY

**Los Alamos, New Mexico**

Operated by the University of California

The Los Alamos National Laboratory (LANL) is dedicated to developing world-class science and technology for the Nation's security and well-being. In addition to continuing its special role in defense, LANL's multidisciplinary capabilities are also used to solve important civilian problems.

In pursuing this mission, the Laboratory maintains a safe and healthful workplace, thus protecting the environment. No activity or operation is carried out at LANL unless it can be performed in a manner designed to protect employees, the public, and the environment.

### DESIGNATED SCIENTIFIC USER FACILITIES

Clinton P. Anderson Meson Physics Facility (linear accelerator, biomedical electronics, electrosurgery, implants, medical instrumentation, and cancer therapy)
Los Alamos National Environmental Research Park
Manual Lujan Jr. Neutron Scattering Center
National Flow Cytometry and Sorting Research Resource
National Genetic Sequence Data Bank (GenBank)
National Stable Isotopes Resource
Weapons Neutron Research (WNR) Facility

### EDUCATIONAL PROGRAM CONTACT

David Sanchez
Educational Outreach Office
Los Alamos National Laboratory
P.O. Box 1663, MS P-370
Los Alamos, NM 87545
(505) 665-8899

## LOS ALAMOS NATIONAL LABORATORY

| | Audience | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Earth Day Poster Contest | S (K-6) | 19 | 1 d | | x | x | x | | | x | 12 | Northern NM |
| Expanding Your Horizons | S, T (5-12) | | 1 d | | x | x | | x | | | 114 | NM |
| Exploring Science with Teens | S, T (6-8) | | 6 m | | x | x | x | x | | | 2000 | NM |
| Family Math | S, T (4-6) | | 6 w | | x | x | x | x | | | 400 | NM |
| High School Co-Op | S (12) | | 9 m | | x | x | | x | x | | 75 | NM |
| Los Alamos Science Student Program | S (10-12) | | 4 m | | x | x | x | x | | | 150 | NM |
| Los Alamos Summer Science Student Program | S (10-12) | | 2 m | x | | x | x | x | x | | 25 | NM |
| Middle School Summer Science Camp (MSSSC) | S (7-8) | | 2 w | x | | x | x | x | | | 28 | NM |
| National Science Bowl | S (9-12) | 14 | 2 d | | x | | x | x | | | 75 | NM |
| New Mexico High School Supercomputing Challenge | S, T (9-12) | | 6 m | | x | | x | x | | x | 500 | NM |
| Practical Applications for Young Science Journalists (PAYS) | S (11-12) | | 4 w | x | | x | x | x | x | | 6 | NM |
| Science at Home (SAH) | T (K-8) | | 50 d | x | x | x | x | x | x | x | 5 | NM |
| Science Beginnings | S (4-6) | | 1 d | | x | | x | | | | 1600 | NM |
| Science Beginnings at the Laboratory | S, T (6) | | 1 d | | x | x | | x | | | 620 | NM |
| Science Beginnings for Teacher Enhancement | T (4-6) | | 3 y | x | x | x | | x | x | | 21 | NM |
| Science Internship Program | S (12) | | 9 m | | x | x | | x | x | | 13 | NM |
| Science Youth Days | S, T (6-10) | | 1 d | | x | x | | x | | | 425 | NM |
| Star Lab | S (K-6) | | 1 d | x | x | | x | | | | 20 | NM |
| Students Watching Over Our Planet Earth (SWOOPE) | S, T (K-12) | 17 | 1 y | x | x | x | x | x | x | x | 6000 | National |
| Summer Educational Experiences for the Disadvantaged (SEED) | S (10-12) | 20 | 3 m | x | | x | | x | x | | 17 | NM |
| Teacher Opportunities to Promote Science (TOPS) | T (6-8) | 18 | 3 y | x | x | x | x | x | x | | 25 | NM |
| Teacher Research Associates (TRAC) Program | T (9-12) | 16 | 8 w | x | | x | x | x | x | | 24 | National |
| [illegible] | | | | | | | | | | | | |
| Environmental Management Career Opportunities for Minorities (EMCOM) Program | U, G, F | | 3 m | x | x | x | | x | x | | 6 | AZ, NM |
| Environmental Management Career Opportunities Research Experience (EMCORE) Program | U, G, F | | 3 m | x | x | x | | x | x | | 16 | National |
| Faculty Research Participation | F | 20 | 2 m,<br>3 m | x | x | x | | x | x | | 20 | National |
| Graduate Research Assistant Program | G | | 1 y | x | x | x | x | x | x | | 500 | National and International |
| Graduate Student Research Participation | G | 20 | 3 m | x | | x | | x | x | | 25 | National |
| Graduate Student Thesis Research | G | 18 | 1 y | x | x | x | | x | x | | 15 | National |
| Historically Black Colleges and Universities Program | U, G | | 3 m | x | x | x | | x | x | | 30 | National |
| J. Robert Oppenheimer Research Fellowships | P | | 3 y | x | x | x | | x | x | | 6 | National and International |
| Minority Access to Energy Related Research Careers (MAERC) | U | 20 | 3 m | x | x | x | | x | x | | 12 | GA |
| Minority Institution Laboratory Alliances | U, G | 21 | 3 m | x | | x | | x | x | | 15 | [illegible] |
| National Consortium for Graduate Degrees for Minorities in Engineering and Science | G | | 6 m | x | | x | | x | x | | 2 | National |
| National Physical Science Consortium (NPSC) | G | | 3 m | x | | x | | x | x | | 7 | National |
| Postdoctoral Research Appointments | P | | 3 y | x | x | x | | x | x | | 300 | National and International |
| Science and Engineering Research Semester (SERS) | U | 18 | 4 m | | x | x | | x | x | | 60 | National |
| Service Academy Research Associates | U, G, F | | 6 w | x | x | x | x | x | x | | 126 | National |

Continued

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## LOS ALAMOS NATIONAL LABORATORY

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **UNDERGRADUATE AND GRADUATE (continued)** | | | | | | | | | | | | |
| Summer of Applied Geophysical Experience (SAGE) | U, G, F | | 1 m | ● | ● | | ● | ● | ● | ● | 20 | National and international |
| Undergraduate Student Research Participation (SRP) | U | ● | 3 m | ● | ● | ● | | ● | ● | | 150 | National |
| University Co-Ops: New Mexico Schools | U | | 6 m | ● | ● | ● | | ● | ● | | 20 | NM |
| **PUBLIC UNDERSTANDING OF SCIENCE AND OTHER** | | | | | | | | | | | | |
| Waste Management Education and Research Consortium (WERC) | U, G | | 3 m | ● | ● | ● | ● | ● | ● | ● | 10 | NM |

Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.
On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).
Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

CONSTRUCTION
LYSIS

A summer student in the Los Alamos Science Internship Program shows a chemical color change to her science instructor. The Pojoaque High School student spent her summer attending morning sessions that provide enrichment in science, mathematics, and communication skills and afternoon sessions that involve research with a laboratory mentor.

A Pojoaque High School student learns to make precise measurements during his semester in the Los Alamos Science Student Program, an after-school series that he attends two evenings a week.

## MORGANTOWN ENERGY TECHNOLOGY CENTER

**Morgantown, West Virginia**

Operated by the U.S. Department of Energy

The Morgantown Energy Technology Center (METC) conducts and manages research and development to enhance the use of U.S. fossil-energy resources. Activities at METC focus on developing technologies to increase coal use in an environmentally acceptable manner, to extend the reserve base of natural gas and oil, and to provide economically and environmentally improved techniques for extracting energy from oil shales and tar sands. The goal of these activities is to expand the technology base for fossil-energy production, conversion, and use. In addition to in-house research and development, other projects at METC are executed through contracts with industry and academia. METC has major mission responsibilities for the following fossil-energy technologies: surface coal gasification, fluidized-bed combustion, gas-stream cleanup, heat engines, fuel cells, waste management, underground coal gasification, arctic and offshore research, unconventional gas recovery, oil shale, and tar sands. METC also shares major mission responsibilities for enhanced oil recovery, clean coal technology, and environmental protection.

**EDUCATIONAL PROGRAM CONTACT**
Larry Headley
Applied Science Division
Morgantown Energy Technology Center
P.O. Box 880
Morgantown, WV 26507-0880
(304) 291-4314

Students extract fossils from a geological matrix and identify them at a workshop hosted by the Morgantown Energy Technology Center to encourage the study of fossil fuels.

## MORGANTOWN ENERGY TECHNOLOGY CENTER

| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **[illegible]** | | | | | | | | | | | | |
| Earth Day Poster Contest | S (4-8) | 10 | 1 m | | • | • | • | • | | • | 300 | WV |
| Future Scientists and Engineers Days | S (9-12) | | 2 d | | • | • | | • | | | 40 | WV |
| Hands-On Elementary School Science Workshop | T | | 2 d | | • | • | | • | • | • | 50 | WV |
| Math Curriculum Program | T | | 6 m | | • | • | | • | • | • | 25 | WV |
| Mentors Bureau | S (9-12) | | 10 d | | • | • | | • | | | 15 | WV |
| Morgantown Energy Technology Center (METC) Education Resource Center | S, T (K-12) | 81 | | | • | • | • | • | | • | 21 | WV |
| National Science Bowl® | S (9-12) | 10 | 1 d | | • | | • | • | | | 40 | WV |
| Scouts Explorer Program | S (9-12), U | | Ongoing | | • | • | • | • | | • | 5-20 | WV (local) |
| Speakers Bureau | S (K-12), T | | 6 d | | • | | • | • | | • | 15 | WV |
| Teacher Research Associates (TRAC) Program | T (7-12) | 16 | 2 m | • | | • | | • | • | • | 4 | National |
| **[illegible]** | | | | | | | | | | | | |
| Faculty Research Participation | F | 36 | 2 y | • | • | • | | • | • | | 5 | WV |
| Faculty Research Program for Historically Black Colleges and Universities (HBCUs) | F | | 1 y | • | | • | | • | • | | 5 | National |
| Graduate Cooperative Education | G | | 2 y | | | • | • | • | • | • | 10 | National |
| Postgraduate Research Program | P | 27 | 3 y | • | • | • | | • | • | | 3 | National |
| Undergraduate Cooperative Education | U | | 2 y | | | • | | • | • | • | 20 | National |
| **[illegible]** | | | | | | | | | | | | |
| School Partnership Program | S (K-12), T | 40 | 9 m | • | • | • | • | • | | • | 30 | WV (local) |

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## MOUND FACILITY

**Miamisburg, Ohio**

Operated by EG&G Mound Applied Technologies

Mound is an integrated research, development, and production facility performing work in support of the U.S. Department of Energy weapons and energy programs, with emphasis on development, explosives, and nuclear technology. The weapons program missions include process development, production engineering, manufacturing, and surveillance of detonators, explosive timers, explosive actuated transducers, explosive pellets, nuclear components, and specific testing equipment. The main function at Mound is to manufacture nonnuclear components and tritium-containing components for nuclear weapons. Some of these areas include development of small heat sources, plutonium-238 isotopic heat sources, and tritium processes and materials; recovery and purification of tritium; and separation, purification, and sale of stable isotopes. In addition, Mound conducts multidisciplinary research and development on materials and instrumentation in association with all program activities.

**EDUCATIONAL PROGRAM CONTACT**
Lucy Anne Cates
Education Outreach Coordinator
EG&G Mound Applied Technologies
P.O. Box 3000
Miamisburg, OH 45343-3000
(513) 561-4332

Members of the Harrison High School Science Bowl Team, winners of the regional Science Bowl, practice with the manipulators in the Mound Space Power Source Fabrication Facility.

## MOUND FACILITY

| | Audience[1] | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Academic Year Activities | Summer Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Staff Involvement | Participants Receive Stipends[3] | Instructional Materials Available | Annual Participation | Geographical Focus of Programs (Principal States or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | X | X | X | | | X | 1128 | OH |
| Junior Achievement | S | | 9 m | | X | | X | X | | | 25 | OH |
| Mathematics Collaborative/Teacher Associates | T (7-12) | | 2 m | X | | X | X | X | X | | 2 | OH |
| Miamisburg High School Science Program | S (9-12) | | 1 d | | X | | X | X | | | 200 | OH |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | X | X | X | | X | 250 | IN, MI, OH |
| New Futures Program | S (7-8) | 22 | 1 d | | X | | X | X | | | 600 | OH |
| Science Demonstration Program | S (1-12) | 22 | 1 d | X | X | | X | X | | | 6000 | OH |
| Speakers Bureau | S | | 1 d | | X | | X | X | | | 200 | OH |
| Teacher Research Associates (TRAC) Program | T (9-12) | 18 | 2 m | X | | X | X | X | X | | 4 | OH |
| Teacher Training Workshops | T (1-8) | | 5 d | X | | | X | X | | X | 70 | OH |
| **UNDERGRADUATE AND GRADUATE** | | | | | | | | | | | | |
| Cooperative Education Program | U | | 4 y | X | X | X | | X | X | | 10 | IN, KY, OH |
| Faculty Research Participation | F | 36 | 3 m | X | X | X | | X | X | | 2 | OH, PA |
| Graduate Student Research Participation | G | 38 | 3 y | X | X | X | | X | X | | 3 | OH, PA |
| Undergraduate Student Research Participation (SRP) | U | 33 | 3 m | X | | X | | X | X | | 2 | IN, KY, MI, OH |
| University of Dayton: Electro-Optics Lab | G | | 1 y | | X | | X | | X | | 2 | OH |
| University of Dayton Women in Engineering Scholarship | U | | 1 y | | X | | X | | X | | 2 | OH |
| Wilberforce University Scholarship | U | | 1 y | | X | | X | | X | | 3 | OH |
| Wright State University Endowed Scholarship | U | | 1 y | | X | | X | | X | | 2 | OH |
| **PUBLIC UNDERSTANDING OF SCIENCE AND OTHER** | | | | | | | | | | | | |
| Dayton Museum of Natural History—Physical Science Center Support | General | | 1 m | | X | | X | X | | | 150000 | IN, KY, MI, OH |
| Mound–University of Dayton Women in Engineering | S (10-12) | | 5 d | X | | | X | X | X | | 20 | OH |
| Public Television "3-2-1 Contact" Support | S (1-6) | | 1 y | | X | | X | X | | X | 28000 | IN, KY, OH |
| School Partnership Program | S (9-12) | 46 | 9 m | | X | X | X | X | | | 20 | OH |
| Student Employment Encourages Kids (SEEK) | S (10-12) | | 3 m | X | | X | X | X | X | | 30 | OH |

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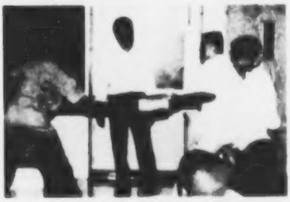

Kevin Jackson, team member of the EG&G Mound Applied Technologies Science Outreach Program, watches as junior high school students wrestle with the forces of atmospheric pressure during a recreation of the Magdeburg sphere experiment.

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## NATIONAL RENEWABLE ENERGY LABORATORY

**Golden, Colorado**

Operated by Midwest Research Institute

The National Renewable Energy Laboratory (NREL) conducts basic and applied research in the physical, chemical, biological, and engineering sciences pertinent to solar and renewable energy resources. Research activities are carried out in six technical divisions: Photovoltaics, Alternative Fuels, Industrial Technologies, Analytic Studies, Utility Systems, and Basic Sciences. Research in all areas is directed toward developing practical alternative-energy technologies for supplying energy, improving energy efficiency, and helping to ensure a cleaner environment. The latter goal is accomplished by using these alternative-energy technologies in environmental-remediation strategies.

**EDUCATIONAL PROGRAM CONTACT**
Linda Lung
Education Programs Administrator
National Renewable Energy Laboratory
1617 Cole Blvd., Bldg. 17
Golden, CO 80401-3933
(303) 231-7044

This student shows attention to detail while constructing a vehicle for the Young Scholars Alert Program

## NATIONAL RENEWABLE ENERGY LABORATORY

| | Audience¹ | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities² | Off-Site Activities² | Direct Staff Involvement | Participants Receive Stipends³ | Instructional Materials Available | Annual Participation | Geographical Focus of Programs (Principal States or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Colorado Alliance for Science Teacher Research Associate Fellowship | T (7-12) | | 2 m | X | | X | x | X | x | | 2 | AZ, CO, NM, UT, WY |
| Colorado Science Bowl Mentors | S | | 2 m | | x | | x | X | | | 15 | CO, WY |
| Colorado Science Olympiad Mentors | S | | 2 m | | x | | x | X | | | 8 | CO, WY |
| Colorado State Science Fair | S (7-12) | | 3 d | | | | | X | x | | 600 | CO |
| Council of Energy Resource Tribes Student Internships and Fellowships (CERT) | T (9-12), U, G | 9 | 2.5 m | X | | X | x | X | x | X | 25 | National |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | x | X | x | | | X | 500 | CO |
| Expanding Your Horizons Conference for Women | S, T (6-9) | | 1 d | | x | X | x | X | | X | 300 | CO |
| Frontiers of Science | S (11) | | 1 d | X | | X | x | X | | | 50 | CO |
| Hands-On Science Outreach (HOSO) | S, T (K-12) | | 6 m | X | x | X | x | X | x | X | 160 | CO |
| International Chemistry Olympiad | S | | 1 d | | x | | x | X | | | 16 | National |
| International Science and Engineering Fair Special Awards | S, T (9-12) | 12 | 10 d | X | x | X | x | X | x | | 1600 | National |
| Junior Solar Sprint | S, T (7-8) | 33 | 5 d | | x | X | x | X | | X | 300 | CO |
| National Geographic KidsNetwork | S, T (4-6) | 14 | 6 m | | x | | x | X | | X | 30000 | National |
| National Science Bowl® | S, T (9-12) | 14 | 3 d | X | x | X | x | X | x | | 100 | CO |
| New Explorers Partners | S, T (4-8) | 16 | 10 d | | x | X | x | X | | X | 50 | CO |
| Physical Science | S, T (K-6) | | 3 d | X | x | | x | X | | X | 6000 | CO |
| Pikes Peak Solar/Electric Challenge | S, T (7-12) | | 2 d | | x | | x | X | | X | 150 | CO |
| Regis Institute for Chemistry Education (RICE) | S, T (4-9) | | 14 d | X | | | x | X | x | X | 20 | CO |
| Renewable Energy Newsletter | S, T (K-6) | | 9 m | | x | | x | X | | X | 10000 | National |
| Science Projects in Renewable Energy and Energy Efficiency | S, T (K-12) | | | | | | | X | | X | | National |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | | X | x | X | x | | 9 | National |
| Trends and Issues in Renewable Energy | T (7-12) | | 2 m | X | x | X | x | X | x | X | | [illegible] |
| Young Scholars Alert Program | S, T (7-12) | 18 | 3 w | X | | X | x | X | | X | 45 | National |
| **[illegible]** | | | | | | | | | | | | |
| Council of Energy Research Tribes (CERT) Student Research | U, G | 9 | 2.5 m | X | | X | x | X | x | X | 2 | National |
| Distinguished Lecturer Program | U, G, F, P | | 10 d | | x | | x | X | | | 2 | National |
| Energy and Minerals Field Institute Fellowship | G | | 4 m | X | x | | x | | x | | 1 | National |
| Environmental Management Career Opportunities for Minorities (EMCOM) Program | U, G, F | | 12 m | X | x | X | x | X | x | | 4 | National |
| Environmental Management Career Opportunities Research Experience (EMCORE) Program | U, G, F | | 12 m | X | x | X | x | X | x | | | |
| Faculty Research Participation | F | 35 | 3 m | X | x | X | | X | x | | 14 | National |
| Graduate Student Research Participation | G, P | 36 | 12 m | X | x | X | x | X | x | | 33 | National |
| Graduate Student Thesis Research | G, P | 36 | 12 m | X | x | X | x | X | x | | 33 | National |
| Minority Access to Energy-Related Research Careers (MAERC) | U, F | 30 | 12 m | X | x | X | x | X | x | | 11 | CA |
| Postdoctoral Program | P | | 1 y | X | x | X | | X | x | | 38 | National |
| Professional Undergraduate Internship Program (PUIP) | U | | 6 m | X | x | X | | X | x | | | |
| Senior Research Associates/Visiting Professorships | Industry | | 6 m | X | x | X | | X | | | 34 | Industry |
| SunRayce | S, T, U | [illegible] | 2 y | X | x | | x | X | x | X | 880 | National |
| Undergraduate Student Research Participation (SRP) | U | [illegible] | 12 m | X | x | X | x | X | x | | 57 | National |
| **[illegible]** | | | | | | | | | | | | |
| FUTURES | S, T (7-12) | 41 | 5 d | | x | X | x | X | | X | 50 | CO |
| NREL Tours | S, T (K-P) | | 5 d | X | x | X | | X | | | 675 | National |
| Space Age | S, T (4-8) | 47 | 6 d | | x | X | x | X | | X | 250 | CO |

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[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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# NAVAL PETROLEUM RESERVES IN CALIFORNIA

**Tupman, California**

The Naval Petroleum Reserves in California (NPRC) consist of Naval Petroleum Reserve No. 1, better known as Elk Hills, and the adjacent Naval Petroleum Reserve No. 2, Buena Vista Hills. Elk Hills, located approximately 30 miles west of Bakersfield, has contributed billions of dollars to the U.S. Treasury and has offset millions of barrels of imported oil. At Elk Hills, the Department of Energy is a full participant in the petroleum industry, dealing with the same technical and economic opportunities and uncertainties as a large independent oil company. Through Elk Hills, the Department of Energy has joined with the petroleum industry in hydrocarbon recovery, geoscience technology development, and a wide range of environmental protection activities.

**EDUCATIONAL PROGRAM CONTACT**
Todd Goodman
P.O. Box 11
28590 Highway 119
Tupman, CA 93276
(805) 763-6067

Employees participate in Career Day at Emmerson Junior High School in Bakersfield. Students learn about career opportunities at Elk Hills. Also, several displays feature the endangered species program and gas analyzing.

Naval Petroleum Reserve No. 1 participates in various community outreach programs. DOE employee Mike Ruiz awards poster contest winner during Fire Prevention Week.

## NAVAL PETROLEUM RESERVES IN CALIFORNIA

| | Audience¹ | Page Description in Catalog | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Career Days | S (7-8) | | 1 d | | x | | x | X | | | 300 | CA |
| Computer Loan | S | | Ongoing | X | X | | x | | | | | CA |
| Computer Software Donations | T (K-12) | | Ongoing | X | x | | x | | | | | CA |
| DOE Summer Hire Program | S, U | | 3 m | X | x | X | | X | x | | 10 | CA |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | x | X | x | | | X | 150 | Southern CA |
| Field Tours | S, U | | 1 d | X | x | X | | X | | | Varies | CA |
| Mathematics Engineering Science and Achievement (MESA) Outreach Program | S (9-12) | | 1 d | X | x | X | x | X | | | 50 | CA |
| National Science Bowl® | S (9-12) | 14 | 1 d | | x | X | x | X | | | 150 | CA |
| Science Fairs | S (K-12) | | 1 d | | X | | x | X | | | Varies | CA |
| [illegible] | | | | | | | | | | | | |
| College Field Tours | U | | 1 d | X | X | X | | X | | | 50 | CA |
| [illegible] | | | | | | | | | | | | |
| Earth Day | General | | 10 | | x | X | | X | | | 1100 | CA |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses; U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

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Elk Hills, Naval Petroleum Reserve No. 1, participates in Career Day at Emmerson Junior High School. John White of Bechtel Petroleum Operations, Inc., talks with students concerning safety issues.

Students from local elementary schools are invited to Elk Hills to participate in various Earth Day activities. The students on the lawn watch the Indian dancers to commemorate Earth Day.

## NEVADA TEST SITE and YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

**Las Vegas, Nevada**

Operated by the DOE Nevada Field Office

The Department of Energy, Nevada Field Office (DOE/NV), manages operations and programs at the 3500-km² (1350-mi²) Nevada Test Site (NTS). The NTS is a vast outdoor laboratory, primarily for conducting the Nation's nuclear weapons testing program.

DOE/NV also manages Yucca Mountain Site Characterization Project, a major defense low-level radioactive waste disposal site. Education programs conducted at this site are shown in the matrix on page 103. Radiological emergency response programs are based at Nellis Air Force Base, Nevada, and Andrews Air Force Base, Maryland; facilities in the Pacific as part of the Nation's nuclear testing readiness program; U.S. Department of Defense projects; a Liquefied Gaseous Fuels Spill Test Facility; and the National Environmental Research Park.

### DESIGNATED SCIENTIFIC USER FACILITIES

Liquefied Gaseous Fuels Spill Test Facility
National Environmental Research Park

### EDUCATIONAL PROGRAM CONTACT

Rudy Cruz, Educational Outreach Coordinator
Office of External Affairs
DOE Nevada Field Office (DOE/NV)
P.O. Box 98518
Las Vegas, NV 89193-8518
(702) 295-3521

A physics class from Tuba City (Arizona) High School pause at the edge of Sedan Crater on the Nevada Test Site during a Site Tour sponsored by DOE's Nevada Field Office

## NEVADA TEST SITE

| | Audience¹ | [illegible] | Typical Duration [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | Annual Participants | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Career Days/Shadowing | S (12) | | 9 m | | X | X | | X | | | 500 | CA, NM, NV |
| Earth Day Poster Contest | S (K-6) | 16 | 1 d | | X | X | X | | | X | 1000 | NV |
| Harnessed Atom (Student and Teachers Editions) | S, T (6-8) | | 12 m | | X | | X | | | X | 500 | NV |
| JASON Project | S, T (5-8) | 46 | 2 m | | X | | X | X | | X | 30000 | NV |
| LESSON (Lawrence Livermore National Laboratory Elementary School Science Study of Nature) | T (K-12) | 18 | 1 m | X | | X | X | | | X | 50 | NV |
| My Experience As a Space Shuttle Astronaut Presentation | S, F | | 6 d | | X | | X | X | | | 1000 | CA, NV |
| National Science Bowl® | S, T (9-12) | 14 | 2 d | | X | | X | X | | | 200 | AZ, NV, UT |
| NM MESA (Math, Engineering, and Science Achievement) | S | | 9 m | | X | X | X | X | | | 60 | NM |
| Partnership with Career Enrichment Centers | S | | 9 m | | X | X | X | X | | | 200 | NV |
| PAYBAC (Partners and Youth Building A Commitment) | S (6-8) | | 9 m | | X | X | X | X | | | 3000 | NV |
| REACTS Chemistry Demonstrations | S | 46 | 9 m | | X | | X | X | | | 2000 | CA |
| Science Fairs | S (K-12) | | 3 m | | X | | X | X | | | 600 | CA, NM, NV |
| Science Now Scholarships | S (9-12) | | 1 d | | X | X | | X | | | 132 | NV, UT |
| Science Teacher Institute | T (9-12) | | 9 m/7 d | X | | | X | | X | | 12 | NV, UT |
| STEP's Introduction to Technology Program | S, T (6-8) | 46 | 9 m | X | X | | X | X | | X | 90 | NV |
| STEP's Project BUGS | S, T (4-6) | 47 | 1 m | X | | | X | | | | 60 | NV |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | | X | X | X | X | | 9 | NV |
| Tours Computer-Aided Design and Video Areas | S | | 9 m | | X | X | | X | | | 100 | CA, NM |
| Co-Op/Internships | U, G | 39 | 2 y | X | X | X | | X | X | | 35 | CA, NM, NV |
| Fort Valley State College (FVSC)/University of Nevada at Las Vegas (UNLV) 3+2 Program | U | 39 | 10 m | | X | X | X | | | | 30 | GA, NV |
| Luna Vocational Technical Institute Internships | G | | 9 m | | X | X | | X | X | | 3 | NM |
| Partnership for Environmental Technology Education (PETE) | F | 32 | 12 m | X | X | X | X | X | X | | 3 | AZ, CA, HI, NV, UT |
| Partnership with Southwestern Indian Polytechnic Institute | U, F | | 9 m | | X | X | X | X | | | 60 | NM |
| Science and Technology Education Program (STEP) | | 46 | | | | | | | | | | |
| Community College of Southern Nevada Environmental Restoration Technology Program | U | 47 | 12 m | X | X | X | X | X | X | X | 3250 | NV |
| UNLV Environmental Studies Program | U | 47 | 12 m | X | X | X | X | X | X | X | 605 | NV |
| Technical Presentations for Northern New Mexico Community College | U | | 9 m | | X | X | | X | | | 40 | NM |
| Tours of EG&G Energy Measurements' Amador Valley Operations for College Students | U | | 9 m | | X | X | | X | | | 100 | CA |
| UNLV Minority Engineering Program Advisory Board/Committees | U | | 12 m | X | X | | | X | | | 25 | NV |
| Earth Day/Earth Fair | General | | 2 d | | | X | X | X | | | | CA, NV |
| Lied Discovery Children's Museum—Energy Pavilion Exhibit | General | | 12 m | X | X | | X | | | | | NV |
| NTS Speakers Bureau | General | | 1 d | | | X | X | X | | | 200 | NV |
| School Partnership Program | S, T (K-12) | 46 | Ongoing | X | X | X | X | X | | X | 8500 | CA, NV |
| Site Tours/Presentations | General | | 12 m | X | X | X | | X | | | 3272 | NV |
| Sponsorship Educational Radio/TV Programming | General | | 12 m | | | | | | | | | NV |
| Workshop How To Call 911 | General | | 3 d | X | X | | X | X | | | | NV |

¹Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses. U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.
²On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).
³Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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Teacher Research Associates (TRAC) Program teacher Ken Collins from Chaparral High School discusses the stratigraphy and composition of a core drilled at the Nevada Test Site with Linda Linden of Science Applications International Corporation.

Jeanne Cooper, DOE geologist, points out and explains the geological features of Yucca Mountain and its environs to teachers participating in a LESSON Workshop conducted by the Lawrence Livermore National Laboratory/Yucca Mountain Site Characterization Project.

## YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

| | Audience* | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Academic Year Activities | Summer Activities | On-Site Activities† | Off-Site Activities† | Stipends Paid‡ | Participants Receive Academic Credit | Underrepresented Minorities Emphasis | Annual Participants | Geographic Focus of Program (Precollege: States or Cities) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Boy and Girl Scout Geology and Atomic Energy | S (4-11) | | 10 d | X | x | X | | X | | X | 400 | NV |
| JASON Project | S (4-8) | 40 | 2 w | | x | | x | | | X | 30000 | NV |
| Information Office School Field Trips | S (K-5) | | 25 d | X | x | X | | X | | | 800 | NV |
| LESSON (Lawrence Livermore National Laboratory Elementary School Science Study of Nature) Teacher Workshop | S (K-8) | 18 | 12 d | X | x | | x | X | | X | 40 | NV |
| National Science Bowl | S (9-12) | 16 | 4 d | | x | | x | X | | | 150 | NV |
| Nevada Science Project | T (K-12) | | 2 w | X | x | | x | | | X | 30 | NV |
| Science Fairs | S (K-12) | | 30 | | x | | x | X | | | 10000 | NV |
| Site School Field Trip | S (6-12) | | 10 d | | x | X | | X | | X | 1000 | NV |
| Speakers Bureau—School Presentations | S, T (K-12) U, G | | 25 d | X | x | X | x | X | | X | 600 | NV |
| Teacher Research Associates (TRAC) Program | T | 18 | 8 w | X | | X | | X | x | | 3 | NV |
| Teacher Workshops | T (K-12) | | 2 d | X | x | X | x | X | | X | 80 | NV |
| [illegible] | | | | | | | | | | | | |
| Earth Day Exhibit | General | | 1 d | | x | | x | X | | | 1000 | NV |
| Exhibit Program | General | | | | | | | | | | 13000 | NV |
| Lecture Series | Adult | | 25 d | X | x | X | | X | | | 400 | NV |
| Site Tours | General | | | X | x | X | | | | | 6000 | NV |
| Speakers Bureau | Adult | | 25 d | X | x | | x | X | | | 7000 | NV |

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‡Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

**Oak Ridge, Tennessee**

Operated by Oak Ridge Associated Universities

Oak Ridge Institute for Science and Education (ORISE) conducts research, development, and implementation to ensure that energy technologies are effectively used to meet our national energy challenges. ORISE's current emphases are to understand the positive and negative health impacts to individuals and societies resulting from man-made and natural substances, especially from energy and energy-related systems; to ensure that our educational systems produce the scientists, engineers, and technologists needed by society and a public that is literate about science and technology; to upgrade the knowledge base of the scientific, engineering, and technical work force that is vital to our economic health and national well-being; and to provide an integrated understanding of the interactions of our energy system and our environment.

Work at ORISE is concentrated in four major areas: science/engineering education, training and management systems, medical sciences, and energy/environmental systems.

**EDUCATIONAL PROGRAM CONTACT**
Al Wohlpart
Science/Engineering Education Division
Oak Ridge Institute for Science and Education
P.O. Box 117
Oak Ridge, TN 37831-0117
(615) 576-3350

## OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

| | Audience | Page Description in Catalog | Typical Duration in Days (d), Months (m), Years (y) | Academic Year Activities | Summer Activities | On-Site Activities | Off-Site Activities | Direct Student Involvement | Participant Stipends/Support | [illegible] | Annual Participation | Geographic Focus of Program |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | X | X | X | | | X | 150 | TN |
| Environmental Restoration/Waste Management Outreach | S, T (K-12) | | 2 m | X | X | X | X | X | X | | 6 | TN |
| Family Math | S, T (K-7) | | 4 m | X | X | X | X | X | X | X | 3 T | TN |
| MathQuest Camps | S (7-8) | | 10 d | X | | X | X | X | | X | 70 | TN |
| Minority Challenge Program | S (7-12) | | 1 m | X | X | X | X | X | X | | 100 | TN |
| National Geographic KidsNetwork | S (3-7) | 14 | | X | X | X | X | X | X | X | 30 T | TN |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | | X | X | | | 300 | MS, TN |
| Science and Mathematics Action for Revitalized Teaching (SMART) | S, T (K-12) | 27 | Varies | X | X | X | X | X | X | | 400 | TN |
| Teacher Institutes in Fossil Energy | T (5-12) | 18 | 5 d | X | | X | X | X | X | | 50 | National |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | | X | | X | X | X | 8 | National |
| [illegible] | | | | | | | | | | | | |
| Advanced Industrial Concepts Materials Program (Target: African Americans/Native Americans) | G | | 2 y | X | X | X | X | X | X | | 2 | National |
| Environmental Restoration and Waste Management Scholarship Program | U, G | 30 | 4 y | X | X | X | X | X | X | | 40 | |
| Faculty Research Participation | F | 35 | 3 m | X | X | X | X | X | X | | 100 | National |
| Graduate Fellowships | | 35 | | | | | | | | | | |
| Applied Health Physics | G | 35 | 2 y | X | X | X | X | X | X | | 20 | National |
| Environmental Restoration/Waste Management | G | 35 | 1-4 y | X | X | X | X | X | X | | 30 | National |
| Global Change | G | 35 | 1-4 y | X | X | X | X | X | X | | 65 | National |
| Magnetic Fusion Energy Technology | G | 35 | 1-4 y | X | X | X | X | X | X | | 20 | National |
| Magnetic Fusion Science | G | 36 | 1-3 y | X | X | X | X | X | X | | 15 | National |
| Nuclear Engineering and Health Physics | G | 36 | 1-4 y | X | X | X | X | X | X | | 30 | National |
| Radioactive Waste Management | G | 36 | 1-4 y | X | X | X | X | X | X | | 20 | National |
| Graduate Student Research Participation | G | 36 | 1-12 m | X | X | X | | X | X | | 40 | National |
| Graduate Student Thesis Research | G | 36 | 1 y | X | X | X | | X | X | | 15 | National |
| High Temperature Materials Laboratory (HTML) Graduate Student Fellowships | G | | 6 m | X | X | X | | X | X | | 5 | National |
| Historically Black Colleges and Universities (HBCU) Faculty Research Participation | F | | 3 m | X | | X | X | X | X | | 10 | National |
| Historically Black Colleges and Universities (HBCU) Graduate Student Research Participation | G | | 2 m | X | | X | | X | X | | 5 | National |
| Historically Black Colleges and Universities (HBCU) Undergraduate Student Research Participation | U | | 2 m | X | | X | | X | X | | 10 | National |
| Industrial Hygiene Fellowships | G | | 2 y | X | X | X | X | X | X | | 20 | |
| Internship Programs | U, G | | 3-12 m | X | X | X | | X | X | | 150 | National |
| Minority Institution Research Travel | F, G | | 3 d | X | X | X | X | X | X | | 30 | National |
| Minority Students Hazardous Materials Training | U | | 2 y | X | X | X | X | X | X | | 5 | TN |
| Nuclear Engineering Training Program for HBCUs | U, G | | 1-4 y | X | X | X | X | X | X | | 25 | National |
| Nuclear Regulatory Commission Fellowships | G | | 2 y | X | X | X | X | X | X | | 20 | |
| Postgraduate Research Fellowships | | 37 | | | | | | | | | | |
| Alexander Hollaender | P | 37 | 2 y | X | X | X | | X | X | | 15 | National |
| DOE Distinguished Postdoctoral Research | P | 37 | 3 y | X | X | X | | X | X | | 10 | National |
| Fossil Energy | P | 37 | 2 y | X | X | X | | X | X | | 15 | National |
| Fusion Energy | P | 37 | 2 y | X | X | X | | X | X | | 6 | National |
| Global Change | P | 37 | 2 y | X | X | X | | X | X | | 25 | National |
| Human Genome | P | 37 | 2 y | X | X | X | | X | X | | 10 | National |

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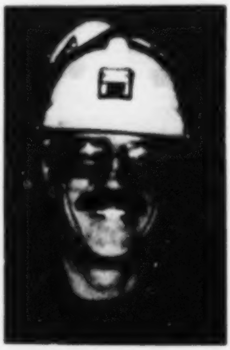
## OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

| | Audience[1] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | Annual Participation | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **UNDERGRADUATE AND GRADUATE (Cont'd)** | | | | | | | | | | | | |
| Postgraduate Research Training Programs | P | | 2 y | X | X | X | | X | X | | 135 | National |
| Research Travel Contracts | G, F | | 3 d | X | X | X | | X | X | | 400 | National |
| Science and Engineering Research Semester (SERS) | U | 33 | 4 m | | X | X | | X | X | | 100 | National |
| Undergraduate Student Research Participation Programs (SRP) | U | 33 | 2 m | X | | X | | X | X | | 50 | National |
| User Groups | G | | 1 m | X | X | X | | X | | | 50 | National |
| Women in Science Conference | S, U, G, F, P | | 2 d | | X | | X | X | | | 400 | National |
| **PUBLIC UNDERSTANDING OF SCIENCE AND OTHER** | | | | | | | | | | | | |
| Analysis of Labor Market Trends | | | | | | | | X | | | | |
| Energy Employment and Education Data Systems | | | | | | | | X | | | | |
| High Temperature Materials Laboratory (HTML) Industrial Fellowships | Private Ceramic Industry | | 6 m | X | X | X | | X | | | 5 | National |
| Program Follow-Up Assessment | | | | | | | | X | | | | |
| Technical Workforce Needs Assessment | | | | | | | | X | | | | |
| Traveling Lecture Program | U, G, F | | 1 d | | X | | X | X | | | 125 | National |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses; U for undergraduate students; G for graduate students; F for college or university faculty; and P for postgraduates.

[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.



Carleton Johnson, a teacher from South Boston High School in Massachusetts, trades fashion for safety during the Teacher Institutes in Fossil Energy.

Students at MathQuest, a mathematics initiative operated by Oak Ridge Institute of Science and Education, applied mathematics to a variety of everyday and scientific situations, including stream population studies.

## OAK RIDGE NATIONAL LABORATORY

**Oak Ridge, Tennessee**

Operated by Martin Marietta Energy Systems, Inc.

Oak Ridge National Laboratory (ORNL) is a large, multidisciplinary research and development center whose primary mission is to carry out applied research and engineering development in fusion, fission, and other energy technologies and scientific research in basic physical and life sciences to underpin work in the energy technologies. A secondary mission of ORNL is to use its resources to address other nationally important issues, such as hazardous and chemical wastes and nonnuclear defense technologies, when such work is closely related to the primary mission.

ORNL also designs and provides research facilities for the benefit of members of the scientific and technical community and is the site of 11 major user facilities and other unique resources for academic and industrial research. In addition, ORNL is a national and regional resource for the education and training of technical personnel and is one of the Southeast's major employers of technically trained graduates.

**DESIGNATED SCIENTIFIC USER FACILITIES**
Atomic Physics EN Tandem Accelerator
Bioprocessing Research Facility
High-Temperature Materials Laboratory
Holifield Heavy Ion Research Facility
National Center for Small-Angle Scattering Research
Neutron Scattering Facility
Oak Ridge Electron Linear Accelerator (ORELA)
Oak Ridge National Environmental Research Park
Roof Research Center
Shared Research Equipment (SHARE) Microanalysis Facility
Surface Modification and Characterization Research Center

**EDUCATIONAL PROGRAM CONTACT**
Chester Richmond
Office of Science Education and External Relations
P.O. Box 2008, 105 Mitchell Rd., MS-6496
Oak Ridge National Laboratory
Oak Ridge, TN 37831-6496
(615) 576-3886

Oak Ridge National Laboratory's support of Wesleyan College's Math and Science Spectacles offers these middle school girls the opportunity to explore and discover at the Freels Bend Environmental Site in Oak Ridge, Tennessee

## OAK RIDGE NATIONAL LABORATORY

| | Audience | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m), Years (y) | Summer Activities | Academic Year Activities | On-Site Activities | Off-Site Activities | Direct Staff Involvement | Participants Receive Stipends | Instructional Materials Available | Annual Participation | Geographical Focus of Program (Particular States or Cities) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| Adventures in Supercomputing | T (10-12) | | 12 d | X | X | X | X | X | X | X | 19 | TN |
| Alternative Certification for Math and Science Teachers | T (6-12) | [illegible] | 12 m | X | X | X | X | X | X | X | 12 | TN, SE states |
| ARC Summer Science Honors Academy | S (11-12) | | 14 d | X | | X | X | X | | X | 50 | AL, GA, KY, MD, MS, NC, NY, OH, PA, SC, TN, VA, WV |
| Clinch River Environmental Studies Organization (CRESO) | S, T (10-12) | | 12 m | X | X | | X | X | X | | 25 | TN |
| Earth Day Poster Contest | S (K-6) | 16 | 1 d | | X | X | X | | | X | 500 | TN |
| Ecological and Physical Sciences Study Center | S (K-12) | | 5 d | X | X | X | X | X | | X | 24000 | TN |
| High School Science Student Honors Program | S (11-12) | 11 | 14 d | X | | X | X | X | | | 60 | National |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | | X | X | | | 200 | AL, GA, MS, NC, TN |
| National Science Foundation Teacher Enhancement Project | T (K-6) | | 15 d | X | | X | X | X | X | X | 45 | TN |
| Partnerships at the Laboratory in Science (PALS) | S, T (K-12) | | 5 d | | X | X | X | X | | X | | TN |
| Saturday Academy of Computing and Mathematics | S (11-12), T | | 4 d | | X | X | | X | | X | 100 | TN |
| Science and Mathematics Action for Revitalized Teaching (SMART) | S, T (K-12) | 27 | | X | X | X | X | X | X | | 102 | TN |
| Science Enrichment | T (3-5) | | 2 d | X | X | | X | X | | X | 20 | TN |
| Special Honors Study Program | S (11-12) | | 9-12 m | X | X | X | | X | | | 8 | TN |
| Student Science Experiences | S (K-12) | | 1-10 d | X | X | X | X | X | | X | 50 | TN |
| Summer Educational Experiences for the Disadvantaged (SEED) | S (11-12), T (9-12) | [illegible] | 40 d | X | | X | | X | X | | 20 | PR, TN |
| Teacher Research Associates (TRAC) Program | T (7-12) | 16 | 2 m | X | | X | | X | X | X | 56 | National |
| Teacher Improvement Programs (TIPS) | T (K-12) | | 5-15 d | X | X | X | X | X | X | X | 80 | PR, TN |
| Tennessee Academy for Teachers of Science and Mathematics | T (5-12) | [illegible] | 24 d | X | | X | X | X | X | X | 72 | FL, KY, LA, NC, TN |
| Wesleyan Math and Science Spectacles | S (5-8) | [illegible] | 14 d | X | | X | X | X | | X | 65 | AL, FL, GA, MS, NC, SC, TN |
| | | | | | | | | | | | | |
| Doctoral Thesis Research | G | | 1 y | X | X | X | | X | X | | 11 | National |
| DOE Fellowship Practicums | G | | 3 m | X | X | X | | X | X | | 4 | National |
| Faculty Research Participation | F | 35 | 3-12 m | X | X | X | | X | X | | 42 | National |
| Graduate Student Intern Programs | G | | 3-12 m | X | X | X | | X | X | | 30 | National |
| Graduate Student Research Participation | G | 36 | 1-12 m | X | X | X | | X | X | | 31 | National |
| Historically Black Colleges and Universities (HBCU) Customized Internships | U, G | | 3 m | X | X | X | | X | X | | 10 | National |
| Internship Programs | U | | 3-12 m | X | X | X | | X | X | | 80 | National |
| Law Internship | G | | 3 m | X | | X | | X | X | | 11 | National |
| Martin Marietta Energy Systems Co-Op | U | | 3 m | X | | X | | X | X | | 104 | National |
| Minority Institution Laboratory Alliances | U, G, F | 31 | 3 m | X | X | X | X | X | X | | 25 | National |
| Nuclear Energy Research Associates Program | G, F | | 3-12 m | X | X | X | | X | X | | 3 | National |
| Nuclear Energy Training (NET) Program | U | 32 | 3 m | X | | X | | X | X | | 6 | National |
| Oak Ridge Science Semester | U, F | | 4 m | X | X | X | | X | X | | 18 | IA, IL, IN, MI, MN, OH |
| Postdoctoral Research Appointments | P | 37 | 2 y | X | X | X | X | X | X | | 100 | National |
| Science and Engineering Research Semester (SERS) | U | 33 | 4-6 m | X | X | X | | X | X | | 69 | National |

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## OAK RIDGE NATIONAL LABORATORY

| | Audience[1] | Page Description in Catalog | Typical Duration in Days (d), Weeks (w), Months (m) | Academic Year Activities | Summer Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Student Involvement | Curriculum Related Materials | Stipends/Financial Assistance[3] | Annual Participation | Geographical Focus of Program (National, Regional, State or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **UNDERGRADUATE AND GRADUATE (cont.)** | | | | | | | | | | | | |
| Service Academy Research Associates (SARA) Program | U, G, F | | 2-6 m | X | X | X | | X | X | | 7 | National |
| Summer Program for Historically Black Colleges and Universities | U, G, F | | 3 m | X | | X | | X | X | | 50 | National |
| Summer Technical Internship | U | | 3 m | X | | X | | X | X | | 56 | National |
| Travel Support | G, F | | 5 d | X | X | X | | X | | | 100 | National |
| Undergraduate Student Research Participation (SRP) | U | 33 | 2 m | X | | X | | X | X | | 35 | National |
| **[illegible]** | | | | | | | | | | | | |
| OREN (Oak Ridge Educational Network) | General | 44 | | X | X | | | X | | X | 800 | National |
| School Partnership Program | S, T | 45 | | X | X | X | X | X | | | | TN |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses; U for undergraduate students; G for graduate students; F for college or university faculty; and P for postgraduates.

[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

These students, like others in DOE laboratories, are part of the High School Science Student Honors Program at Oak Ridge National Laboratory (ORNL) studying environmental sciences.

Jorge Quiles-Santiago from Puerto Rico, an Oak Ridge National Laboratory participant in the Summer Educational Experiences for the Disadvantaged (SEED) program, surveyed the vegetation on Walker Branch Watershed in Oak Ridge, Tennessee, looking for changes that had occurred during the previous 20 years; here he points out some of his findings to Milena Holmgren, a University of Tennessee graduate student from Chile.

There is life after graduate school, as 150 postdoctoral students and faculty members learn each year at ORNL. Postgraduate appointments offer the chance to spend anywhere from several weeks to several years working at the frontiers of science. Lorna Ramirez Velez, an instructor at the University of Puerto Rico, works with lasers.

Science has a slimy side, as these students at Knoxville's School for the Deaf learn by concocting a batch of "goo." Their teacher, Alisa Weeks, is one of nearly 50 teachers a year attending ORNL's summer "science camp," part of the National Science Foundation Teacher Enhancement Project.

ORNL is a "natural" partner in elementary science education. Nearly 20,000 students and teachers a year experience the wonders of nature at ORNL's Freels Bend outdoor education center. Here 7th graders from Knoxville explore the fields and woods around a 200-year-old East Tennessee cabin. Thousands of primary and secondary students experience ORNL science education through such programs as the Saturday Academy of Computing and Mathematics.

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## ■ PACIFIC NORTHWEST LABORATORY

**Richland, Washington**

Operated by Battelle Memorial Institute

Sallie Sanders of Atlanta, Georgia, enjoyed her Teacher Research Associates (TRAC) Program at Pacific Northwest Laboratory where she studied the reduction of iron in soils by dissimilatory iron-reducing bacteria.

The missions of the Pacific Northwest Laboratory (PNL) are the advancement of science and the rapid development and deployment of technology. As a DOE multiprogram laboratory, PNL has the staff and the facilities to carry out research and development activities in the physical, biological, chemical, environmental, materials, and computational sciences. Engineering capabilities at PNL are currently being applied in the development of technologies for waste management, environmental restoration, efficient energy use, nuclear energy, and national security. Transferring technology to users in the public and private sectors, developing and operating scientific user facilities for researchers from these sectors, and contributing to the enhancement of science and mathematics education are integral parts of PNL's programmatic activities.

Current research and development activities at PNL focus on gaining scientific understanding of phenomena at the molecular level; improving the scientific understanding of subsurface-contaminant transport and global environmental processes; characterizing and remediating hazardous-waste sites; increasing energy efficiency in buildings and industrial processes; modernizing the federal infrastructure, including the nuclear-weapons complex; and linking research and development activities at universities, DOE laboratories, and industry.

PNL also provides technical support for activities at the DOE Hanford Site, including independent environmental surveillance and oversight.

**DESIGNATED SCIENTIFIC USER FACILITIES**
Hanford National Environmental Research Park

**EDUCATIONAL PROGRAM CONTACT**
Irene Hays
Science Education Center
Pacific Northwest Laboratory
P.O. Box 999, MS K1-66
Richland, WA 99352
(509) 375-2584

## PACIFIC NORTHWEST LABORATORY

| | Audience* | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Curriculum Enhancement Activities | T (K-12) | | | X | X | X | X | X | | X | | National |
| FCCSET Federal Laboratory Teacher Training Program | T (6-12) | [illegible] | 20 d | X | X | X | X | X | X | X | 60 | National |
| High School Science Student Honors Program | S (10-12) | [illegible] | 15 d | X | | X | X | X | | | 60 | National |
| High School Student Research Apprenticeship Program (SRAP) | S (10-12) | [illegible] | 40 d | X | X | X | X | X | X | | 23 | WA |
| Honors High School Student Marine Ecology Institute | S (10-12) | | 7 d | | X | X | | X | | | 12 | WA |
| Inquiry into Science and Engineering (ISE) | S (11-12) | | 9 m | | X | X | | X | X | | 15 | [illegible] |
| Mathematics, Engineering, and Science Achievement (MESA) Enrichment Program | S, T (6-12) | | Periodic | | X | X | X | X | | | 500 | WA |
| National Teachers Institute in Materials Science and Technology | T (9-12) | [illegible] | 15 d | X | | X | | X | X | X | 30 | National |
| OPTIONS | S, T (5-6) | [illegible] | All year | X | X | X | X | X | X | | 2000 | [illegible] |
| Science Alive | T (5-8) | | 10 d | X | X | X | X | X | X | | 25 | [illegible] |
| Sharing Science with Schools | S (4-12) | | All year | | X | | X | X | | | 10000 | [illegible] |
| State Systemic Initiative/Washington | S, T (K-16) | [illegible] | All year | X | X | X | X | X | | | | [illegible] |
| Teacher Research Associates (TRAC) Program | T (7-12) | [illegible] | 40 d | X | | X | | X | X | X | 40 | National |
| Technology in Education (TIE) | T (7-12) | | 2-3 d | | X | X | X | X | | | 90 | [illegible] |
| Young Scientists | S (1-6) | | 4 d | | X | X | | X | | | 300 | [illegible] |
| [illegible] | | | | | | | | | | | | |
| Environmental Management Career Opportunities for Minorities (EMCOM) | U, G, F | | 1 y | X | X | X | X | X | X | | 12 | AL, GA, LA,<br>MS, [illegible], TX |
| Environmental Management Career Opportunities Research Experience (EMCORE) | U, G, F | | 1 y | X | X | X | X | X | X | | 8 | National |
| Environmental Management Community College Curriculum | S, T, U | | 1 y | X | X | X | X | X | X | | 90 | WA |
| Faculty Research Participation | F | [illegible] | 3 m | X | X | X | | X | X | | 40 | National |
| Fellowship Program | F | | 1 y | X | X | X | X | X | X | | 10 | National |
| Graduate Student Research Participation | G | [illegible] | 1 y | X | X | X | X | X | X | | 84 | National |
| Graduate Student Thesis Research | G | [illegible] | 3 m | X | | X | | X | X | | 12 | National |
| Hispanic and American Indian Scholars Program | U | | 4 y | X | X | X | X | X | X | | 7 | AZ, MT |
| Joint Research Appointees | G, F, P | | 3 m | X | X | X | X | X | X | | 20 | National |
| Joint Research Projects | G, F, P | | 3 m | X | | X | | X | X | | 6 | National |
| "Life Gets Better" Scholarship Program | U | | 4 y | X | X | X | X | X | X | | 4 | FL |
| National Physical Science Consortium | S, G | | 6 y | X | X | X | X | X | X | | 4 | National |
| PNL Affiliate Scientist Staff | F | | 1-3 y | X | X | | X | X | X | | 17 | ID, MT, OR,<br>WA |
| PNL Energy Research Fellowships | G | | 1 y | X | X | | X | | X | | 12 | ID, MT, OR,<br>WA |
| Science and Engineering Research Semester (SERS) | U | [illegible] | 4 m | | X | X | | X | X | | 75 | National |
| Scientist/Faculty Exchanges | F | | 6 m-1 y | | X | | X | X | X | | 6 | National |
| Undergraduate Student Research Participation (SRP) | U | [illegible] | 3 m | X | | X | | X | X | | 100 | National |
| Women's College Internships | S, U | | 2 m | X | | X | | X | X | | 4 | [illegible] |
| [illegible] | | | | | | | | | | | | |
| Oregon Museum of Science and Industry Initiative | General | | | | | | X | X | | | | OR |

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## PANTEX PLANT

**Amarillo, Texas**

Operated by Mason & Hanger-Silas Mason Co., Inc.

The mission of Pantex Plant is fourfold: fabrication of chemical high explosive components that go into nuclear weapons, assembly of nuclear weapons for the nation's stockpile, maintenance and evaluation of weapons, and ultimate disassembly of retired nuclear weapons.

**EDUCATIONAL PROGRAM CONTACT**
Vanessa Tatum
Community Relations
P.O. Box 30020
Amarillo, TX 79177
(806) 477-3772

Annette Mitchell was one of more than 20 Pantexans who taught science classes at Amarillo area schools as part of the Voyage of the Mimi program.

## PANTEX PLANT

| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Amarillo College Prep Student Scholarship | S (7-12) | | | ☒ | | | x | | | | 1 | TX |
| Career Days | S (9-12) | | | | x | | x | ☒ | | | 1000 | TX |
| Earth Day Poster Contest | S (K-6) | [illegible] | 1 d | | x | ☒ | x | | | ☒ | 250 | Northern TX |
| Engineer Yourself - Stay in School | S (7-12) | | 1 d | | | | x | ☒ | | | 600 | TX |
| High Plains Regional Science Fair | S (3-12) | | 1 d | | | | x | ☒ | | | 310 | TX |
| Panhandle Area Science Conference | T (1-12) | | 1 d | | | | x | ☒ | | | 250 | TX |
| Need to Succeed | S (3) | | | | x | | x | | | | 80 | TX |
| Regional Science Bowl | S (9-12) | | 1 d | | | | x | ☒ | | | 180 | TX |
| Step Up to Success | S (7-12) | | 1 d | | | | x | ☒ | | | 500 | TX |
| Student Tours | S, T (9-12) | | Ongoing | | | ☒ | | ☒ | | | 1500 | TX |
| Texas Alliance for Minorities in Engineering | S (7-12) | | | | x | | x | ☒ | | | 50 | TX |
| TexPrep | S (7-12) | | | ☒ | | | x | ☒ | | | 150 | TX |
| Voyage of the Mimi | S (5) | [illegible] | | | x | | x | ☒ | | | 1100 | TX |
| Women in Science Endeavors | S (7-8) | | 1 d | | | | x | ☒ | | | 250 | TX |
| [illegible] | | | | | | | | | | | | |
| Pantex Scholarship Program | U | | | | x | | x | ☒ | | | 10 | TX |
| Teacher Enhancement Program | T, G | | | ☒ | | ☒ | x | ☒ | | | 8 | TX |
| [illegible] | | | | | | | | | | | | |
| KACV-TV PBS Broadcasting | General | | 6 m | | | | x | | | | | TX |
| Public Tours | General | | Ongoing | | | ☒ | | ☒ | | | 1500 | TX |
| Speakers Bureau | General | | Ongoing | | | ☒ | x | ☒ | | | 100 | TX |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

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Pantexan Annette Mitchell explains how animation works to a group of fifth graders at Western Plateau Elementary.

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## PITTSBURGH ENERGY TECHNOLOGY CENTER

**Pittsburgh, Pennsylvania**

Operated by the U.S. Department of Energy

The Pittsburgh Energy Technology Center (PETC) is responsible for the technical and administrative management of 12 primary-mission research and development programs within the DOE Office of Fossil Energy. In addition to the Pittsburgh facility, PETC has administrative responsibilities for the petroleum and natural-gas research and development programs at the National Institute for Petroleum and Energy Research (NIPER) through the DOE Bartlesville (Oklahoma) Project Office. In conjunction with these program responsibilities, PETC has established a National Coal Technology Data Center where users may have access to government databases on coal research in PETC's lead-laboratory areas. PETC's responsibilities are grouped within the following areas: environmental concerns (coal preparation, advanced combustion, flue-gas cleanup, and alternative fuels), energy conversion (magnetohydrodynamics, coal liquefaction, and advanced research in liquefaction), and fundamental research (University Coal Research, solids transport, and direct use). PETC manages projects under the congressionally mandated Clean Coal Technology Program.

**EDUCATIONAL PROGRAM CONTACT**
Fred Brown
Office of Research and Development
Pittsburgh Energy Technology Center
P.O. Box 10940
Pittsburgh, PA 15236
(412) 892-5942

Teacher Mim Bizic has participated in the Teacher Research Associates (TRAC) Program and the Teacher Institute in Fossil Energy representing the Pittsburgh Energy Technology Center. She has worked with DOE to develop with "USA Today" a teaching resource called Geographic Connections.

## PITTSBURGH ENERGY TECHNOLOGY CENTER

| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Earth Day Poster Contest | S (K-8) | 10 | 1 d | | X | X | X | | | X | 200 | PA |
| Monongahela Valley Education Consortium's High School Student Research Apprenticeship | S | | 4 m | | X | X | | X | | | 10 | PA |
| National Science Bowl® | S (9-12) | 14 | 2 d | | X | | X | X | | | 300 | PA |
| PETC Chemistry in Motion (Van) | T (7-12) | | 1 d | X | X | | X | X | | | 50 T<br>2500 S | PA |
| PETC Science and Engineering Volunteers for Education (SERVE) Program | T (6-12) | | 1 d | X | X | | X | X | | | 34 | PA |
| Teacher Research Associates (TRAC) Program | T (7-12) | 18 | 2 m | X | | X | | X | X | | 11 | National |
| Triple E Seminar | T (K-6) | 20 | 2 d | | X | X | X | X | | | 100 | PA |
| [illegible] | | | | | | | | | | | | |
| Coal Science and Technology Course | T (7-12) | | 2 m | X | | X | | X | | | 0 | |
| Fossil Energy Faculty Research Participation for Historically Black Colleges and Universities (HBCUs) | F | | 3 m | X | X | X | | X | X | | 0 | National |
| Fossil Energy Faculty Research Participation Program | F | 30 | 3 m, 1 y | X | X | X | | X | X | | 10 | National |
| Fossil Energy Professional Internship Program | G | | 3 m-1 y | X | X | X | | X | X | | 31 | National |
| Fossil Energy Student Research Participation for Historically Black Colleges and Universities (HBCUs) | U, G | | 3 m | X | X | X | | X | X | | 0 | National |
| Fossil Energy Technology Internship Program | U | | 3-6 m | X | X | X | | X | X | | 0 | National |
| Graduate Student Research Participation Program | G | 30 | 12 m | X | X | X | | X | X | | 1 | National |
| Laboratory Graduate Participation Program | G | | 6-12 m | X | X | X | | X | X | | 1 | National |
| Postgraduate Research Training Program | P | | 1 y | X | X | X | | X | X | | 15 | National |

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## PRINCETON PLASMA PHYSICS LABORATORY

**Princeton, New Jersey**

Operated by Princeton University

The primary mission of the Princeton Plasma Physics Laboratory (PPPL) is research in magnetic fusion, which is conducted with the Tokamak Fusion Test Reactor and associated experimental equipment. PPPL is a world leader in research and development aimed primarily at the use of magnetic fusion energy as a safe, economical, and environmentally acceptable method of generating electricity to meet our Nation's long-term energy needs. In support of the primary mission, extensive research and development is done in neutral-beam technology, remote handling of nuclear systems, plasma engineering, plasma diagnostics, surface modification technology, magnetic field systems, radio-frequency heating and current drive, computer systems, diagnostic systems, theoretical and applied physics, and soft X-ray development.

**EDUCATIONAL PROGRAM CONTACT**
Diane L. Carroll
Science Education Program Office
Princeton Plasma Physics Laboratory
P.O. Box 451
Princeton, NJ 08543
(609) 243-2107

Two young scientists are discovering life under the microscope at Central School in Somerville, New Jersey, as part of the New Explorers Partners program. Princeton Plasma Physics Laboratory staff assisted in this initiative.

## PRINCETON PLASMA PHYSICS LABORATORY

| | Audience* | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Fractals, Chaos, and Dynamics | T (7-10) | | 5 d | x | | x | | x | | x | 100 | National |
| National Geographic KidsNetwork | T (3-6) | 14 | 5 d | x | x | x | x | x | x | x | 30 | NJ |
| PPPL-Trenton Public Schools Partnership | S, T (K-12) | 25 | 12 m | | x | | x | x | | | 1800 | NJ |
| School Tours | S, T, U, P | | 5 d | x | x | x | | x | | x | 1500 | NJ, NY, PA |
| Science on Saturday | S, T | | 8 d | | x | x | | x | | | 475 | NJ, PA |
| Science over Supper | T (4-6) | | 4 d | | x | x | | x | | x | 200 | NJ, PA |
| Student Co-Op | S (11) | | 4 m | | x | x | | x | | | 6 | NJ |
| Summer Science Awards | S (11-12) | | 2 m | x | | x | | x | x | | 15 | NJ, PA |
| Summer Teachers Institute | T (4-8) | | 20 d | x | x | x | | | x | x | 40 | NJ |
| Teacher Research Associates (TRAC) Program | T (9-12) | 16 | 2 m | x | x | x | | x | x | x | 11 | National |
| Telecommunications in K-12 Classroom | T (K-12) | | 1 d | | x | x | | x | | x | 60 | NJ, PA |
| [illegible] | | | | | | | | | | | | |
| Graduate Education Opportunities | G | | 5 y | x | x | x | | x | x | x | 40 | National |
| National Undergraduate Fellowships in Plasma Physics and Fusion Engineering | U | 20 | 2.5 m | x | | x | x | x | x | x | 20 | National |
| Summer Research Opportunities | U | | 2 m | x | | x | | x | x | | 10 | NJ |
| Undergraduate Co-Op Programs | U | | 6 m | x | x | x | | x | x | | 15 | NJ |
| Undergraduate Student Research Participation (SRP) | U | 30 | 3 m | | x | x | | x | | | 5 | National |
| [illegible] | | | | | | | | | | | | |
| Tours | S, T, U, G, F | | | x | x | x | | x | | | 1500 | NJ, NY, PA |

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Participants in the Summer Teachers Institute at the Princeton Plasma Physics Laboratory build and use curriculum materials that can be adapted to their classroom needs.

## ROCKY FLATS PLANT

**Golden, Colorado**

Operated by EG&G, Inc.

The Rocky Flats Plant (RFP) is located about 16 miles northwest of Denver, Colorado, and previously served as a key facility in the Department of Energy's nationwide nuclear weapons research, development, and production complex. Its new mission includes decontamination and decommissioning of facilities, environmental restoration, waste management, economic development, and maintenance of the capability to produce nuclear weapons components if needed in the future for our national defense.

**EDUCATIONAL PROGRAM CONTACTS**
Laura Schachter
DOE Rocky Flats Office
P.O. Box 928
Golden, CO 80402-0928
(303) 966-2200

Eileen Jemison
EG&G Rocky Flats, Inc.
P.O. Box 464-T130F
Golden, CO 80402-0464
(303) 966-2302

Sigurd Jauranias and Lisa Craig from the Rocky Flats Plant show participants at the Education/Career Expositions how environmental monitoring equipment can monitor the properties of liquids.

## ROCKY FLATS PLANT

| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Centers for Applied Technology | S, T (6-9) | | 9 m | | X | | X | X | | | 600 | CO |
| Education/Career Expositions | S, T (K-16) | | 1 d | | | | X | X | | | 8000 | CO |
| Expand Your Horizons Conference | S, T (6-9) | | 1 d | | X | | X | X | | | 450 | CO |
| Expanding the Visions | S (8-12) | | 1 d | | X | | X | X | | | 400 | CO |
| Exploratory Technology Laboratories Program | S | 25 | 9 m | | X | | X | X | | | 150 | CO |
| Joint Science Association Projects | S (K-12) | | varies | X | X | X | X | X | | | 1500 | CO, WY |
| Mentorship Programs | S (K-12) | | varies | | X | X | X | X | | | 50 | CO |
| Mobile Educational Laboratory | S, T (K-12) | | 9 m | X | X | X | X | X | | | 30 | CO |
| National Science Bowl® | S (10-12) | 14 | 1 m | | X | X | X | X | | | 125 | CO |
| Regis Institute of Chemistry Education (RICE) Summer Camp | S, T (4-12) | | 14 d | X | | | X | X | | | 100 | CO, WY |
| Review Rocky Flats Site Specific Plan | S, T (10-12) | | 6 w | | X | | X | X | | | 40 | CO |
| Science Fair Programs for Region and State | S (K-12) | | 9 m | | X | | | X | | | 500 | CO |
| Speakers Bureau Tours | S, T, U, F, P | | 1 d | X | X | | X | X | | | 4000 | CO |
| Teacher Education Workshops | T | | 9 m | X | | X | X | X | X | X | 200 | CO |
| Teacher Research Associates (TRAC) Program | T (7-12) | 10 | 2 m | X | | X | | X | X | | 1 | National |

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Junior high students participating in a Rocky Flats Plant Mentorship Program test the toxicity of water with a Microtox instrument.

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# SANDIA NATIONAL LABORATORIES/ CALIFORNIA and SANDIA NATIONAL LABORATORIES/ NEW MEXICO

**Livermore, California**
**Albuquerque, New Mexico**

Operated by Martin Marietta
Corporation

This multiprogram laboratory has major facilities at Albuquerque, New Mexico, Livermore, California, and test site at Tonopah, Nevada, applying its engineering and scientific capabilities to areas of national importance. These programs are nuclear weapons technology, energy research, and others that are in the national interest. In its nuclear weapons programs, Sandia National Laboratories performs research, development, engineering for production, and stockpile surveillance with particular emphases on nuclear weapons safety and command and control. In the energy area, they perform research and development leading to improved concepts for recovering and using energy resources, for generating electricity, and for understanding the energy sciences.

Sandia National Laboratories is committed to enhancing the economic competitiveness of the United States by creating, developing, and transferring technology through cooperative arrangements with industry, universities, and other research institutions. Educational programs are administered at both sites.

**DESIGNATED SCIENTIFIC USER FACILITIES**
Combustion Research Facility—California
Solar Thermal Test Center—New Mexico

**EDUCATIONAL PROGRAM CONTACTS**
**Karen P. Scott**
Education Outreach Program Manager
Sandia National Laboratories/California
P.O. Box 969
Livermore, CA 94551
(510) 294-3760

**Bill Dawes**
Education Outreach
Sandia National Laboratories/New Mexico
P.O. Box 5800
Albuquerque, NM 87185
(505) 844-9364

Bob Carling demonstrates the basics of air pressure by subjecting a marshmallow man to a vacuum at a Livermore, California, school as a part of Sandia National Laboratories' traveling Science/Math Carnival.

## SANDIA NATIONAL LABORATORIES/ CALIFORNIA

| | Audience[1] | Page Description in Catalog | Time Duration in Days (d), Months (m), or Years (y) | Academic Year Activities | Summer Activities | On-Site Activities[2] | Off-Site Activities[2] | [illegible] | Stipends[3] | Group Participation | Number of Participants | Geographic Area of Program (National, State or City) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRECOLLEGE** | | | | | | | | | | | | |
| Bay Area Science and Technology Education Collaboration (BASTEC) | T (K-12) | 27 | Ongoing | X | x | X | x | X | x | | 4130 | CA |
| Expanding Your Horizons | S (7-12) | | 1 d | | x | | x | X | | | 600 | CA |
| FCCSET Federal Laboratories Teacher Training Program | T (6-10) | 10 | 1 m | X | | | | X | x | X | 50 | National |
| Industry Initiative for Science and Math Education (IISME) | T (6-12) | | 2 m | X | | X | | X | x | | 2 | CA |
| Math Science Awards Colloquium | S | | 1 d | | x | | x | X | | | 10 | CA |
| Math Through Applications | T | | 2 m | X | | X | | X | x | | 10 | National |
| National Science Bowl® | S (9-12) | 14 | 1 d | | x | | x | X | | | 75 | CA |
| Sandia/Chemical Education for Public Understanding Program (CEPUP) | T (7-9) | | 14 d | X | x | | x | X | | X | 60 | CA |
| School Links | S, T | | 1 y | | x | | x | X | | | 60 | CA |
| Science/Math Carnivals | S, T (K-8) | 28 | 1 d | X | x | | x | X | | X | 400000 S,<br>1300 T | CA |
| Summer Teacher Institute | T (K-8) | | 5 d | X | x | X | | X | x | X | 25 | CA |
| Teacher Research Associates (TRAC) Program | T (6-12) | 18 | 2 m | X | | X | | X | x | | 12 | National |
| **UNDERGRADUATE AND GRADUATE** | | | | | | | | | | | | |
| AT&T Corporate Research Fellowships | G | | 5 y | X | | X | | X | x | | 1 | National |
| Faculty Fellowship | F | | 2 y | X | x | X | | X | x | | 2 | National |
| Faculty Research Participation | F | 35 | 3 m | X | | X | x | X | x | | 4 | National |
| Historically Black Colleges and Universities (HBCU) Program | U, G, F | | 3 m | X | | X | | X | x | | 6 | National |
| Laboratory Graduate Fellowship | G | | 1 y | X | x | X | | X | x | | 5 | National |
| Las Positas Scientific Honors Program | U | | 3 m | X | | X | | X | x | | 2 | CA |
| Outstanding Student Summer Program | U, G | | 3 m | X | x | X | x | X | x | | 25 | National |
| Partnership for Environmental Technology Education (PETE) Summer Internship | F | 32 | 2 m | X | | X | | X | x | | 15 | AZ, CA, HI, NV, UT |
| Postdoctoral Program | P | | 2 y | | | X | | X | x | | 6 | National |
| Student Fellowship | S, U | | 1 y | X | x | X | | X | x | | 11 | National |
| Undergraduate Engineering Co-Op | U | | 3 m | X | x | X | | X | x | | 6 | National |
| **PUBLIC UNDERSTANDING OF SCIENCE AND OTHER** | | | | | | | | | | | | |
| Breaking Through Video | S (9-12) | 30 | | | | | | | | X | | National |
| Science Seminars | T (K-12) | | 7 d | | x | X | | X | | | 200 | CA |
| Summer Employment for Minority Youth (SEMY) | S, U | | 3 m | X | | X | | X | x | | 2 | CA |

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Teachers participating in the Sandia/CEPUP partnership learn first hand presentation techniques for an issue-oriented science curriculum.

Gennysburgh Izquierdo from the University of Turabo in Puerto Rico is learning radio lithography from the Compound Semiconductor Tech Department at Sandia National Laboratories/New Mexico.

Betsy Martinez from the University of Turabo in Puerto Rico is learning about studies of the atmosphere from the Pollution Prevention Department at Sandia National Laboratories/New Mexico

## SANDIA NATIONAL LABORATORIES/ NEW MEXICO

| | Audience¹ | Page Description is Given | Typical Duration in Days (d), Weeks (w), Months (m) or Years (y) | Academic Year Activities | Summer Activities | On-Site Activities² | Off-Site Activities² | Participants Receive Stipends³ | [illegible] | [illegible] | Annual Participation | Geographical Area of Program Recruitment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| High School Science Student Honors Program | S (11-12) | [illegible] | 2 w | X | | X | | X | | | | [illegible] |
| National Science Bowl® | S (9-12) | [illegible] | 1 d | | X | | X | X | | | 250 | [illegible] |
| Science Advisors (SCIAD) Program | T (K-8) | [illegible] | Ongoing | | X | | X | X | | | 64000 | [illegible] |
| Summer Teacher Enrichment Program (STEP) | T (6-12) | | 2 m | X | | X | | X | X | | 8 | [illegible] |
| Teacher Opportunities to Promote Science (TOPS) | T (6-8) | [illegible] | 3 y | X | X | X | X | X | X | | 25 | [illegible] |
| Teacher Research Associates (TRAC) Program | T (6-12) | [illegible] | 2 m | X | | X | | X | X | | 4 | [illegible] |
| [illegible] | | | | | | | | | | | | |
| Associated Western Universities (AWU) Laboratory Postgraduate Program | P | [illegible] | Varies | X | X | X | X | X | X | | 30 | Western U.S. |
| Faculty Research Participation | F | [illegible] | Varies | X | | X | X | X | X | | 20 | [illegible] |
| Faculty Sabbatical Program | F | | Varies | X | | X | X | X | X | | 2 | [illegible] |
| Historically Black Colleges and Universities Program | U, G, F | | 3 m | X | | X | | X | X | | 7 | [illegible] |
| Minority Engineering and Science Graduate Fellowship Programs | U, G | | 3 m | X | | X | | X | X | | Varies | National |
| Minority Institution Laboratory Alliances | U | 31 | Varies | X | | X | X | X | X | | Varies | [illegible] |
| New Mexico Summer Drafting Program | S, U | | 3 m | X | | X | | X | X | | 10 | [illegible] |
| Outstanding Student Summer Program | U, G | | 2 m | X | X | X | X | X | X | | 109 | [illegible] |
| Postdoctoral Program | P | | 1 y | | | | X | X | X | | 13 | [illegible] |
| School of Education SCIAD Program | F | | 1 y | | X | | X | X | | | | |
| Undergraduate Engineering Co-Op | U | | 6 m | X | X | X | | X | X | | 17 | [illegible] |
| [illegible] | | | | | | | | | | | | |
| Expanding Your Horizons | S (7-12) | | 1 d | | X | | X | X | | | Varies | [illegible] |
| Hands-On/Minds-On Technology Program | S (5-12) | | 6 w | | X | | X | X | | | 200 | [illegible] |
| School Partnership Program | S (K-12) | 46 | 1 y | | X | | X | X | | | Varies | [illegible] |
| Summer Employment for Minority Youth (SEMY) | S, U | | 3 m | X | | X | | X | X | | 66 | [illegible] |

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¹Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and P for postgraduates.

²On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

³Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## SAVANNAH RIVER ECOLOGY LABORATORY

**Aiken, South Carolina**

Operated by the University of Georgia

The Savannah River Ecology Laboratory (SREL) conducts ecological research on the 300 square-mile Savannah River Site (SRS). The goal of the SREL education and research programs is to provide opportunities for student and faculty investigators who wish to use the unique field facilities of the SRS for ecological training and research.

**EDUCATIONAL PROGRAM CONTACT**
J.W. Gibbons
Education Program Coordinator
Savannah River Ecology Laboratory
Drawer E
Aiken, SC 29802
(803) 725-5204

Research technician Ann Chazal and student Gay Heagler collect mosquitofish samples from a tank on the Savannah River Site to test them for mercury uptake

## SAVANNAH RIVER ECOLOGY LABORATORY

| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Teacher Research Associates (TRAC) Program | T (7-12) | 10 | 2 m | X | | X | X | X | X | | 5 | National |
| [illegible] | | | | | | | | | | | | |
| Faculty Research Participation | F | [illegible] | 3 m | X | X | X | | X | X | | 1 | National |
| Graduate Student Research Participation | G | [illegible] | 1 y | X | X | X | | X | X | | 10 | National |
| Graduate Student Thesis Research Program | G | [illegible] | 3 m | X | X | X | | X | X | | 25 | National |
| Undergraduate Student Research Participation (SRP) | U | [illegible] | 3 m | X | X | X | X | X | X | | 20 | National |
| [illegible] | | | | | | | | | | | | |
| Environmental Outreach and Education Program | General | [illegible] | | | | | | | | | | |

[1] Symbols represent the following: S for precollege students and T for precollege teachers with specific grade levels in parentheses, U for undergraduate students, G for graduate students, F for college or university faculty, and (P) for postgraduates.

[2] On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.).

[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

In a study of hazardous-waste-management techniques at the Savannah River Site, graduate students Bruce Herbert and Don Kaplan measure the growth of bamboo grass in a rhizotron lysimeter, an instrument that allows scientists to observe root growth.

Student Lynn Oliver uses a global positioning system that receives signals from the NAVSTAR satellite network. She uses the determined geographic coordinates on the Savannah River Site in processing remotely sensed and other spatial data.

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## ■ SAVANNAH RIVER TECHNOLOGY CENTER

**Aiken, South Carolina**

Operated by Westinghouse
Savannah River Company

The Savannah River Technology Center (SRTC) provides development and technical assistance in all areas of nuclear reactor technology and the nuclear fuel cycle, including fuel fabrication, robotics technology, isotope production, reactor physics and engineering, fuel reprocessing, waste management, and environmental monitoring. The primary program areas at SRL are nuclear materials production and defense waste management.

**EDUCATIONAL PROGRAM CONTACT**
Michael Hodges
Outreach Education Office
Savannah River Technology Center
P.O. Box 616, Bldg. 773-42A
Aiken, SC 29802
(803) 725-5328

Peter Hockman, Manager of the DOE Savannah River Office, presents certificates to the energy winners of the National Science and Engineering Fair hosted by the Savannah River Technology Center

## SAVANNAH RIVER TECHNOLOGY CENTER

| | Audience[1] | Page Description is Given | Typical Duration in Days (d), Weeks (w), Months (m), or Years (y) | Summer Activities | Academic Year Activities | On-Site Activities[2] | Off-Site Activities[2] | Direct Staff Involvement | Participant Stipends Offered[3] | Instructional Materials Available | Annual Participation | Geographic Focus of Program (Principal States or Other) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | X | X | X | | | X | 1000 | SC |
| National Science Bowl® | S (9-12) | 14 | 1 d | | X | | X | X | | | 120 | GA, SC |
| Science Fair | S | | 9 m | | X | | X | X | | X | 25 | GA, SC |
| Teacher Research Associates (TRAC) Program | T | 18 | 2 m | X | | X | | X | | | 11 | National |
| Faculty Research Participation | F | 38 | 3 m | X | | X | | X | | | 7 | MD, SC |
| Graduate and Undergraduate Summer Technology Program | G, U | | 3 m | X | | X | | X | | | 111 | GA, SC |
| Graduate Student Research Participation | G | 38 | 3 m | X | | X | | X | | | 10 | National |
| Math Excellence | U | | 25 d | X | | | X | | | | 22 | SC |
| University Partnerships for Environmental Restoration and Waste Management Research and Development and Education | S T U G F | 34 | 5 y | X | X | X | X | X | | | 1700 | SC |
| University Partnerships for Health and Safety Research and Development and Education | S T U G F | | 5 y | X | X | X | X | X | | | 500 | GA |
| Visiting Lecturer | F U G | | 1 y | | X | | X | | | | 1300 | National |
| Mentor Training Program | S (5-8) | | 1 y | | X | | X | | | X | 30 | GA, SC |

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[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## STANFORD LINEAR ACCELERATOR CENTER

**Stanford, California**

Operated by Stanford University

The Stanford Linear Accelerator Center (SLAC) is dedicated to experimental and theoretical research in elementary particle physics and to the development of new technologies for high energy accelerators and elementary particle detectors.

**DESIGNATED SCIENTIFIC USER FACILITIES**
SLC, a 100-GeV linear electron/positron collider
PEP, a 32-GeV colliding-beam, storage-ring facility 800 meters in diameter

**EDUCATIONAL PROGRAM CONTACT**
P. A. Moore
Education Office
Stanford Linear Accelerator Center
P.O. Box 4349, Bin 81
Stanford, CA 94309
(415) 926-3826

Andria Erzberger, lead teacher at the Stanford Linear Accelerator Center, confers with members of her team about the development of teaching aids for science and math teachers to use in their classrooms.

## STANFORD LINEAR ACCELERATOR CENTER

| | Audience¹ | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | Annual Participation | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **[illegible]** | | | | | | | | | | | | |
| Bay Area Science and Technology Education Collaboration (BASTEC) | S, T (K-12) | 87 | Ongoing | X | X | X | X | X | X | X | 4138 | CA |
| Curriculum Materials Development | S, T, U | | Ongoing | | | | | | | X | NA⁴ | National |
| Local Teacher Research Associates | T (9-12) | | 2 m | X | | X | | X | X | | 5-8 | CA |
| Physics and Chemistry Teacher Summer Workshops | T (9-14) | | 2 w | X | X | X | | X | X | | 35 | CA, NV |
| Teacher Research Associates (TRAC) Program | T (7-12) | 88 | 8 w | X | | X | | X | X | X | 2 | National |
| Sequoia Union Program | S (9-12) | | 3 m | X | | X | | X | | | 10 | CA |
| **[illegible]** | | | | | | | | | | | | |
| Graduate Student Program | G | | Ongoing | X | X | X | | X | X | | 250 | National |
| Research Associate Program | P | | Ongoing | X | X | X | | X | X | | 50 | National |
| Special Workshops/Programs | G, P, F | | Varies | X | X | X | | X | | | 1000 | National |
| Summer Science Program | U | | 9 w | X | | X | | X | X | | 19 | National |
| The Consortium Program - Engineering Internships | U, G | | 2 y | X | X | X | | X | X | | 4 | National |
| Undergraduate Research Projects | U | | Ongoing | X | X | X | | X | | | 3-5 | CA |
| **[illegible]** | | | | | | | | | | | | |
| Apprenticeship Program | General | | Varies | X | X | X | | X | | | 2 | CA |
| Expanding Your Horizons | S (7-12) | | 1 d | | X | | X | X | | | 660 | CA |
| Site Tours | General | | 1 d | X | X | X | | X | | | 6000 | National |
| Work-Study Program | U | | 3 m | X | X | X | | X | X | | 6-10 | CA |
| Youth Opportunity Program | S | | 3 m | X | | X | | X | X | | 5-10 | CA |

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⁴Materials used by many thousand students; over 5,000 copies distributed in past year, most for classroom use.

Sean Brennan of the Stanford Linear Accelerator Center staff gestures emphatically as he describes the workings of an experiment during an educators' tour of the Stanford Synchrotron Radiation Lab.

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## STRATEGIC PETROLEUM RESERVE

**New Orleans, Louisiana**

Operated by the U.S. Department of Energy

The Department of Energy created the Strategic Petroleum Reserve (SPR) in 1975 to serve as the Nation's emergency oil stockpile in the event of an energy emergency. The SPR is the result of a national commitment to energy emergency preparedness. The reserve, whose headquarters are located in New Orleans, Louisiana, currently stores more than 570 million barrels of crude oil in 5 underground salt domes along the Louisiana and Texas Gulf Coast. On order of the President, the oil is removed and sold to the highest bidder. The SPR has 750 million barrels of storage space available and studies are under way to increase its storage capability to 1 billion barrels.

**EDUCATIONAL PROGRAM CONTACT**
Durinda Robinson
900 Commerce Road East
New Orleans, LA 70123
(504) 734-4312

Department of Energy employee Durinda Robinson observes P. A. Capdau Junior High School students working in the school's Computer Lab. Capdau acquired computer equipment in the lab through its partnership in education with the DOE Strategic Petroleum Reserve.

## STRATEGIC PETROLEUM RESERVE

| | Audience | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| Earth Day Poster Contest | S (K-6) | 10 | 1 d | | x | X | x | | | X | 50 | LA |
| Energy Awareness Poster Contest | S (K-6) | | 1 d | | x | X | x | X | | | 50 | LA |
| Junior Achievement | S (8-12) | | 9 m | | x | | x | X | | | 30 | LA |
| National Science Bowl® | S (9-12) | 14 | 1 d | | x | X | x | X | | | 0 | LA |
| Partners in Education | S (7-8) | | 9 m | | x | X | x | X | | | 400 | LA |
| Summer Industrial Fellowship for Teachers (SIFT) | T (7-12) | | 2 m | X | | X | | X | x | | 1 | LA |
| [illegible] | | | | | | | | | | | | |
| Historically Black Colleges and Universities (HBCU) Summer Intern Program | U | | 2 m | X | | X | | X | x | | 1 | LA |
| Stay-in-School Program | U | | 12 m | X | x | X | | X | x | | 5 | LA |
| [illegible] | | | | | | | | | | | | |
| Speakers Bureau | S, T | | 1 d | X | x | X | x | X | | | 10 | LA |

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[3] Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

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## WESTERN AREA POWER ADMINISTRATION

**Golden, Colorado**

The Western Area Power Administration (WAPA) markets federal power and capacity to a service area that covers parts of the following western states: Arizona, California, Colorado, Iowa, Kansas, Minnesota, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Texas, Utah, and Wyoming. WAPA headquarters is located in Golden, Colorado, and has area offices in Billings, Montana, Loveland, Colorado, Phoenix, Arizona, Sacramento, California, and Salt Lake City, Utah. District offices, operations offices, and duty stations are located throughout the service region.

**EDUCATIONAL PROGRAM CONTACT**
Tom Navarro
Western Area Power Administration
P.O. Box 3402
Golden, CO 80401-3402
(803) 231-1697

Chuck Marquez
Western Area Power Administration
P.O. Box 3402
Golden, CO 80401-3402
(303) 231-1652

The Western Area Power Administration supports education programs throughout its 15-state service area.

DUTY LOCATIONS
CANADA
WASHINGTON
OREGON
IDAHO
TEXAS
HEADQUARTERS
AREA OFFICES
DISTRICT OFFICES
OPERATIONS OFFICE
DUTY STATIONS

## WESTERN AREA POWER ADMINISTRATION

| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | | | | | | | | | | | | |
| California Science Bowl | S | | 2 d | | X | X | X | X | | | 160 | CA |
| California Science Bowl Mentors | S | | 2 m | | X | | X | X | | | 16 | CA |
| Colorado Science Bowl Mentors | S | | 2 m | | X | X | X | X | | | 16 | CO |
| Cooperative Education Program | S (9-12) | | 1 y | | X | | X | X | | | 0 | |
| Council of Energy Resource Tribes (CERT) Student Internships and Fellowships | U | 8 | 2.5 m | | X | | X | X | | | 2 | National |
| Executive High School Internship Program | S | | 1 y | | X | X | X | X | | | 2 | CO |
| Hands-on Science Program | S (K-5) | | 1 y | | X | | X | | X | | 325 | CA |
| Join-A-School Program | S | | 1 y | | X | X | X | X | | X | 46 | CO |
| Mathematics, Engineering, and Science Achievement (MESA) | S | | 1 d | | X | | X | X | | | Varies | CO |
| National Science Bowl® | S (9-12) | 14 | 3 d | | X | | X | X | | | 150 | CO |
| [illegible] | | | | | | | | | | | | |
| Cooperative Education Program | U | | 4 y | X | X | X | X | X | X | X | 41 | AZ, CA, CO, MT, UT |
| Federal Junior Fellowship Program | U | | 4 y | X | X | X | X | X | X | X | 33 | CA, CO, MT, UT |
| Minority Engineering Program/Project Success | U | | 4 y | X | X | X | X | X | X | | 4 | CA |
| Stay in School Program | U | | 4 y | X | X | X | X | X | X | X | 35 | AZ, CA, CO, MT, UT |
| [illegible] | | | | | | | | | | | | |
| Electrical Power Training Center | | | 1 d | | | X | | X | | X | Varies | CO |
| School Partnership Programs | | 40 | 1 y | | | | | | | | 1500 | AZ, CA, CO, MT, UT |

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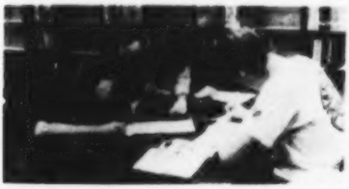

Katrina Bernie, a Federal Junior Fellow in the Salt Lake City Office, tutors eighth graders Eric Hanson and Tyson Delic of Bryant Intermediate School in Salt Lake City as part of the Western Area Power Administration's School Partnership Program.

Kathy Welch supports the Western Area Power Administration's Join-A-School Program by working with eighth grader Erica Hansen of Bryant Intermediate School in Salt Lake City in a one-on-one math session.

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## WESTINGHOUSE HANFORD COMPANY

**Richland, Washington**

Operated by Westinghouse Electric Corporation

Westinghouse Hanford Company is the operations and engineering contractor for the Department of Energy's Hanford Site. It carries out the national missions of the site, including energy research and technology; defense production; management and disposal of radioactive waste; and environmental, health, and safety studies. One of the major facilities that Westinghouse Hanford Company manages is the Fast Flux Test Facility (FFTF). The FFTF is a unique sodium-cooled reactor resource that provides full-scale reactor irradiation test conditions for advanced reactors and space applications. The FFTF is also used in the development of materials for advanced fusion concepts. The Fuels and Materials Evaluation Facility (FMEF) is targeted to house and support a plutonium-238 production line and will be the fabrication and reprocessing base for the FFTF fuel supply. These facilities are fully supported by hot-cell and material-analysis resources.

**EDUCATIONAL PROGRAM CONTACT**
Gwen Leth
Westinghouse Hanford Company
P.O. Box 1970
Richland, WA 99352
(509) 376-5252

Bob Scherter and Luther Buckley of the Westinghouse Hanford Company demonstrate the effects of liquid air to students of the McLoughlin Middle School in Pasco, Washington, as part of the company's outreach program.

## WESTINGHOUSE HANFORD COMPANY

| | Audience¹ | [illegible] | Typical Duration in Days (d), Weeks (w), Months (m) or Years (y) | [illegible] | Academic Year Activities | [illegible] | On-Site Activities² | [illegible] | Participants Receive Stipends³ | [illegible] | Annual Participation | [illegible] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **[illegible]** | | | | | | | | | | | | |
| Ambassadors | S, T (K-12) | | Ongoing | | X | | X | X | | | 7000 | [illegible] |
| American Indian Science and Engineering Society (AISES) Corporate Board | S, T | | 5 d | | X | | X | X | | | 1000 | National |
| Curriculum Distribution to Schools | T (K-12) | | | | X | | X | X | | X | | |
| Development of Environmental Education Programs by Teachers and Hanford (DEPTH) | T (9-12) | | 1 y | | X | | X | X | | | 10 | National |
| Discover E Program | S, T (6-12) | | 1 m | | | | X | X | | | 1500 | [illegible] |
| Energy Awareness Poster Contest | S (K-6) | | 2 m | | | | X | | | X | 3600 | [illegible] |
| Energy Source Curriculum | S, T (K-6) | | Ongoing | | X | | X | X | | | 1000 | [illegible] |
| Environmental Summer Science Camp | S, T (6-7) | | 5 d | X | | | X | X | | | 380 | [illegible] |
| Hanford Science Center | (K-P) | | Ongoing | | X | X | | X | | | 6000 | [illegible] |
| Inquiry into Science | S (10-12) | | 9m | | X | X | | X | | | 75 | [illegible] |
| Native American Employment Programs | S, T | | Ongoing | X | | X | X | X | X | | 22 | [illegible] |
| Shadowing | T (K-12) | | 2 d | | X | X | X | X | | | 220 | [illegible] |
| Student Employment Programs | S | | 3-9 m | X | X | X | | X | | | 460 | [illegible] |
| Teacher Research Associates (TRAC) Program | T (7-12) | X | 2 m | X | | X | | X | X | | | |
| Washington State Talent Search | S (9-12) | | | | X | X | X | X | X | | | |
| **[illegible]** | | | | | | | | | | | | |
| Faculty Research Participation | F | X | | | X | X | | X | X | | | |
| Graduate Student Research Participation | G | X | | | X | X | | X | X | | | |
| Undergraduate Student Research Participation (SRP) | U | X | | | X | X | | X | X | | | |

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²On-site activities take place at the DOE facility; off-site activities take place away from the DOE facility (i.e., in schools, community, university campuses, etc.)
³Stipends refer to any allowances, awards, per diem, or other payments made directly to program participants.

At Westinghouse Hanford's Environmental Summer Science Camp, Joe Estey describes the activities involved in soil and air sampling.

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## ACRONYMS

| | |
|---|---|
| ACT | Argonne Community of Teachers |
| AISES | American Indian Science and Engineering Society |
| ANL | Argonne National Laboratory |
| ARC | Appalachian Regional Commission |
| ASTC | Access to Science Teaching Careers |
| AT&T | American Telephone & Telegraph Company |
| ATOMS | Adventures in Technology Equals Options in Math/Science |
| AWU | Associated Western Universities |
| BASTEC | Bay Area Science and Technology Education Collaboration |
| BEAMS | Becoming Enthusiastic About Math and Science |
| BEEP | Bates Early Education Program |
| BNL | Brookhaven National Laboratory |
| BPA | Bonneville Power Administration |
| CCSN | Community College of Southern Nevada |
| CDEP | Cooperative Developmental Energy Program |
| CEBAF | Continuous Electron Beam Accelerator Facility |
| CEHR | Committee on Education and Human Resources |
| CEPUP | Chemical Education for Public Understanding Program |
| CERT | Council of Energy Resource Tribes |
| CHROME | Cooperating Hampton Roads Organizations for Minorities in Engineering |
| CRESO | Clinch River Environmental Studies Organization |
| CSU | California State University |
| DEPTH | Development of Environmental Education Programs by Teachers and Hanford |
| DOE | Department of Energy |
| DOE/NV | DOE Nevada Field Office |
| DP | Office of Defense Programs |
| ED | Office of Economic Impact and Diversity |
| EE | Office of Energy Efficiency and Renewable Energy |
| EG&G | Edgerton Germeshausen and Grier |
| EH | Office of Environment, Safety and Health |
| EIA | Energy Information Administration |
| EM | Office of Environmental Restoration and Waste Management |
| EMCOM | Environmental Management Career Opportunities for Minorities |
| EMCORE | Environmental Management Career Opportunities Research Experience |
| EMPAC | Environmental Management Precollege Analytical Chemistry |
| EPA | Environmental Protection Agency |

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|---|---|
| EPSCoR | Experimental Program to Stimulate Competitive Research |
| ER | Environmental Restoration |
| ER | Office of Energy Research |
| ERLE | Energy-Related Laboratory Equipment |
| ERT | Environmental Restoration Technology |
| ESD | Education Service District |
| ESME | Emeritus Scientists, Mathematicians, and Engineers |
| ET | Office of Science Education and Technical Information |
| FCCSET | Federal Coordinating Council for Science, Engineering, and Technology |
| FE | Office of Fossil Energy |
| FEDIX | Federal Information Exchange |
| FEMP | Fernald Environmental Management Project |
| FERMCO | Fernald Environmental Restoration Management Corporation |
| Fermilab | Fermi National Accelerator Laboratory |
| FFTF | Fast Flux Test Facility |
| FMEF | Fuels and Materials Evaluation Facility |
| FrEdMail | Free Educational Electronic Mail Network |
| FRP | Faculty Research Participation |
| FVSC | Fort Valley State College |
| GEM | Graduate Education for Minorities |
| GenBank | National Genetic Sequence Data Bank |
| GSRP | Graduate Student Research Participation |
| HACU | Hispanic Association of Colleges and Universities |
| HBCU | Historically Black Colleges and Universities |
| HELP | Hands-On Experimental Laboratory Program |
| HOPES | Helping Our Partners Enrich Science |
| HOS | Hands-On Science |
| HOSO | Hands-On Science Outreach |
| HTML | High Temperature Materials Laboratory |
| HUGS | Hampton University Graduate Studies |
| IIS | Inquiry into Science and Engineering |
| IISME | Industry Initiative for Science and Math Education |
| INEL | Idaho National Engineering Laboratory |
| IQ Line | INEL Query Line |
| ITRI | Inhalation Toxicology Research Institute |
| JETS | Junior Engineering Technical Society |
| LANL | Los Alamos National Laboratory |
| LBL | Lawrence Berkeley Laboratory |
| LESSON | Lawrence Livermore National Laboratory Elementary School Science Study of Nature |
| LLNL | Lawrence Livermore National Laboratory |
| MAERC | Minority Access to Energy-Related Research Careers |

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|---|---|
| MESA | Mathematics, Engineering, and Science Achievement |
| METC | Morgantown Energy Technology Center |
| MI | Minority Institutions |
| MOLIS | Minority On-Line Information Service |
| MOU | Memorandum of Understanding |
| MSEA | Mathematics Science and Engineering Agency |
| MSEB | Mathematical Sciences Education Board |
| MSSSC | Middle School Summer Science Camp |
| MUTEC | Minority Undergraduate Training for Energy Related Careers |
| NAESP | National Association of Elementary School Principals |
| NASA | National Aeronautics and Space Administration |
| NE | Office of Nuclear Energy |
| NEIC | National Energy Information Center |
| NESP | National Education Supercomputer Program |
| NET | Nuclear Energy Training |
| NIPER | National Institute for Petroleum and Energy Research |
| NOAHS | New Opportunities in Animal Health Sciences |
| NPEC | National Physics Education Collaboration Program |
| NPRC | Naval Petroleum Reserves in California |
| NPSC | National Physical Science Consortium |
| NREL | National Renewable Energy Laboratory |
| NSF | National Science Foundation |
| NTS | Nevada Test Site |
| OMSI | Oregon Museum of Science and Industry |
| ORELA | Oak Ridge Electron Linear Accelerator |
| OREN | Oak Ridge Educational Network |
| ORISE | Oak Ridge Institute for Science and Education |
| ORNL | Oak Ridge National Laboratory |
| OUSD | Oakland Unified School District |
| OSTI | Office of Scientific and Technical Information |
| PALS | Partnerships at the Laboratory in Science |
| PALS | Principals for the Advancement of Leadership in Science |
| PATH | Providing a Trusting Hand |
| PAYBAC | Partners and Youth Building A Commitment |
| PAYS | Practical Applications for Young Science Journalists |
| PBS | Public Broadcasting Service |
| PEEP | Plant Engineering Experience Program |
| PETC | Pittsburgh Energy Technology Center |
| PETE | Partnership for Environmental Technology Education |
| PNL | Pacific Northwest Laboratory |
| PPPL | Princeton Plasma Physics Laboratory |
| PREP | PreFreshman Enrichment Program |
| PRETEP | Preservice Teacher Enhancement Program |
| PRIME | Physical Sciences Revisited for Intermountain Educators |
| PUIP | Professional Undergraduate Internship Program |

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|---|---|
| REACTS | Rediscovery Education Activities Create Tomorrow's Scientists |
| RFP | Rocky Flats Plant |
| RICE | Regis Institute of Chemistry Education |
| RW | Office of Civilian Radioactive Waste Management |
| SAGE | Summer of Applied Geophysical Experience |
| SAH | Science at Home |
| SARA | Service Academy Research Associates |
| SCIAD | Science Advisors |
| SEABA | Science Education Academy of the Bay Area |
| SEED | Summer Educational Experiences for the Disadvantaged |
| SEEK | Student Employment Encourages Kids |
| SEMY | Summer Employment for Minority Youth |
| SEP | Summer Employment Program |
| SERS | Science and Engineering Research Semester |
| SERVE | Science and Engineering Volunteers for Education |
| SHARE | Shared Research Equipment |
| SIFT | Summer Industrial Fellowship for Teachers |
| SIPI | Southwest Indian Polytechnic Institute |
| SITE | Students Investigating Today's Environment |
| SLAC | Stanford Linear Accelerator Center |
| SMART | Science and Mathematics Action for Revitalized Teaching |
| SNL | Sandia National Laboratories |
| SOS | Science on Site |
| SPR | Strategic Petroleum Reserve |
| SRAP | Student Research Apprenticeship Program |
| SREL | Savannah River Ecology Laboratory |
| SRP | Student Research Participation |
| SRS | Savannah River Site |
| SRTC | Savannah River Technology Center |
| SSI | State Systemic Initiatives |
| SSC | Superconducting Super Collider |
| ST | Office of the Science and Technology Advisor |
| STEM | Science, Technology, Environment, and Me |
| STEP | Science and Technology Education Program |
| STEP | Student Technology Experience Program |
| STEP | Summer Teacher Enrichment Program |
| STEPS | Successful Teaming for Educational Partnerships in Science |
| SUMS | Students Understanding Mathematics and Science |
| SURA | Southeastern Universities Research Association |
| SWOOPE | Students Watching Over Our Planet Earth |
| TAG | Talented and Gifted |
| TEEM | Teachers Exploring Environmental Management |
| TIE | Technology in Education |
| TIPS | Teacher-Improvement Programs |

| | |
|---|---|
| TOPS | Teacher Opportunities to Promote Science |
| TRAC | Teacher Research Associates |
| TREK | Technology Reaching Elementary Kids |
| UCLA | University of California at Los Angeles |
| UNLV | University of Nevada at Las Vegas |
| URI | University Research Instrumentation |
| USDA | United States Department of Agriculture |
| USDOI | United States Department of the Interior |
| WAPA | Western Area Power Administration |
| WERC | Waste-Management Education and Research Consortium |
| WM | Waste Management |
| WNR | Weapons Neutron Research |

## OTHER DOE RELATED MATERIALS

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Pasedena, CA 91105
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fax: (818) 577-4282

**Energy Education Resources, Kindergarten Through 12th Grade**
This publication is a list of generally available free or low-cost energy-related educational materials for primary and secondary students and educators.

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Energy Information Administration
Room 1F-048, Forrestal Building
1000 Independence Avenue, SW.
Washington, DC 20585
phone: (202) 586-8800
TDD: (202) 586-1181

**Energy Environment Simulator**
The Energy Environment Simulator is a computerized software simulation of our energy resources, energy consumption, and environmental effects.

Contact
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**National Education Supercomputer Program**
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Contact
Sue Wiehe
phone: (510) 423-9394
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Brian Lindow
phone: (510) 294-5464
electronic mail: lindowbl@nersc.gov

National Education Supercomputer Program
P.O. Box 5509
L-561
Lawrence Livermore National Laboratory
Livermore, CA 94551

**NEWTON**

NEWTON is an international computer bulletin board system for teachers, students, and the general public operated by Argonne National Laboratory.

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**Northwest Women in Science**

This publication is a role model guidebook and resource directory to be used by students, teachers, and parents which highlights scientific careers pursued by women.

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**OREN**

OREN, the Oak Ridge Educational Network, is a wide area computer network established by Oak Ridge National Laboratory that provides electronic communication capabilities for educational purposes.

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**Pathways to Excellence—A Federal Strategy for Science, Mathematics, Engineering, and Technology Education**
This report identifies a unitary Federal strategy and program for mathematics and science education involving 16 Federal agencies.

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